FCC SAR Test Report

APPLICANT	:	Lenovo (Shanghai) Electronics Technology Co., Ltd.
EQUIPMENT	:	802.11a/b/g/n/ac + BT 4.1 M.2 2230 Type Card
BRAND NAME	:	Lenovo
MODEL NAME	:	QCNFA344A
FCC ID	:	O57-QCNFA344AH
STANDARD	:	FCC 47 CFR Part 2 (2.1093) ANSI/IEEE C95.1-1992 IEEE 1528-2013

The product was installed into Notebook Computer (Brand Name: Lenovo, Model Name: Lenovo YOGA 920-13IKBXXXXXX, 80Y7XXXXXX, Lenovo YOGA 920-13IKB GlassXXXXXX, 80Y8XXXXXX, Lenovo YOGA 6 ProXXXXXX (The"X"in model name can be 0 to 9, A to Z, a to z,"-"or blank), Marketing Name: Lenovo YOGA 920) during test.

We, Sporton International (KunShan) INC., would like to declare that the tested sample has been evaluated in accordance with the procedures and had been in compliance with the applicable technical standards.

The test results in this report apply exclusively to the tested model / sample. Without written approval of Sporton International (KunShan) INC., the test report shall not be reproduced except in full.

Mark Qu

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Jones Tsai

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ilac-MRA TAF Testing Laboratory 2627

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Table of Contents

Revision History

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FA760219A	Rev. 01	Initial issue of report	Jul. 12, 2017

1. Statement of Compliance

The maximum results of Specific Absorption Rate (SAR) found during testing for **Lenovo (Shanghai) Electronics Technology Co., Ltd., 802.11a/b/g/n/ac + BT 4.1 M.2 2230 Type Card, QCNFA344A**, are as follows.

Equipment Class	Frequency Band	Highest SAR Summary Body 1g SAR (W/kg)
DTS	WLAN 2.4GHz	0.88
NII	WLAN 5GHz	**1.20**
DSS	Bluetooth	<0.10
Date of Testing:		2017/6/25 ~ 2017/6/30

Highest SAR Summary Highest Simultaneous Transmission 1g SAR (W/kg)	
DTS (MIMO)	1.50
NII (MIMO)	**1.58**
DTS+DSS	0.65
NII+DSS	1.20

This device is in compliance with Specific Absorption Rate (SAR) for general population/uncontrolled exposure limits (1.6 W/kg) specified in FCC 47 CFR part 2 (2.1093) and ANSI/IEEE C95.1-1992, and had been tested in accordance with the measurement methods and procedures specified in IEEE 1528-2013 and FCC KDB publications.

2. Administration Data

Testing Laboratory	
Test Site	Sporton International (KunShan) INC.
Test Site Location	No.3-2, Pingxiang Road, Kunshan Development Zone, Jiangsu, China TEL: +86-0512-5790-0158 FAX: +86-0512-5790-0958

Applicant	
Company Name	Lenovo (Shanghai) Electronics Technology Co., Ltd.
Address	NO.68 BUILDING, 199 FENJU RD, China (Shanghai) Pilot Free Trade Zone, Shanghai, 200131 China

3. Guidance Applied

The Specific Absorption Rate (SAR) testing specification, method, and procedure for this device is in accordance with the following standards:

- FCC 47 CFR Part 2 (2.1093)
- ANSI/IEEE C95.1-1992
- IEEE 1528-2013
- FCC KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz v01r04
- FCC KDB 865664 D02 SAR Reporting v01r02
- FCC KDB 447498 D01 General RF Exposure Guidance v06
- FCC KDB 248227 D01 802.11 Wi-Fi SAR v02r02
- FCC KDB 616217 D04 SAR for laptop and tablets v01r02

4. Equipment Under Test (EUT) Information

4.1 General Information

Product Feature & Specification	
Equipment Name	802.11a/b/g/n/ac + BT 4.1 M.2 2230 Type Card
Brand Name	Lenovo
Model Name	QCNFA344A
FCC ID	O57-QCNFA344AH
Wireless Technology and Frequency Range	WLAN 2.4GHz Band: 2412 MHz ~ 2462 MHz WLAN 5.2GHz Band: 5180 MHz ~ 5240 MHz WLAN 5.3GHz Band: 5260 MHz ~ 5320 MHz WLAN 5.5GHz Band: 5500 MHz ~ 5720 MHz WLAN 5.8GHz Band: 5745 MHz ~ 5825 MHz Bluetooth: 2402 MHz ~ 2480 MHz
Mode	WLAN 2.4GHz 802.11b/g/n/ac HT20/HT40/VHT20/VHT40 WLAN 5GHz 802.11a/n/ac HT20/HT40/VHT20/VHT40/VHT80 Bluetooth v3.0+EDR, Bluetooth v4.0 LE, Bluetooth v4.1 LE
EUT Stage	Identical Prototype

Host Feature & Specification	
Equipment Name	Notebook Computer
Brand Name	Lenovo
Model Name	Lenovo YOGA 920-13IKBXXXXXX, 80Y7XXXXXX, Lenovo YOGA 920-13IKB GlassXXXXXX, 80Y8XXXXXX, Lenovo YOGA 6 ProXXXXXX (The"X"in model name can be 0 to 9, A to Z, a to z,"-"or blank)
Marketing Name	Lenovo YOGA 920
Applicant	**Lenovo (Shanghai) Electronics Technology Co., Ltd.** NO.68 BUILDING, 199 FENJU RD, China (Shanghai) Pilot Free Trade Zone, Shanghai, 200131 China
Manufacturer	**Lenovo PC HK Limited** 23/F, Lincoln House, Taikoo Place, 979 King's Road, Quarry Bay Hong Kong

Remark:

1. This EUT has two typical use conditions which are notebook mode and tablet mode.
2. There are two P-sensors in this device making reduce power more reliable, these two sensors are identical, the TX antenna and sensor pad also are identical, the distance between the two sensor pad and device edge side and bottom face is identical, each one connect one antenna to detect the distance from antenna to human body, the power will be reduced regardless of which sensor is triggered at SISO and MIMO mode. If both sensors be simultaneous triggered, the device will choose lower power to set both two antenna. When the device detected sensor failure and malfunctioning, the default power level is lower power level.

4.2 Key part List

The key part list is shown in the following table, for battery, with the same capacity, only supplier different. So only chose one battery for SAR testing. Other items we evaluate there have no effect on RF Exposure distribution, so no need to do verify SAR testing for this application.

Item	Supplier	Description
CPU	Intel	Intel i7-8550U 1.8G/4C/8M
		Intel i5-8250U 1.6G/4C/6M
RAM	/	DDR4 8/12/16GB
SSD	Samsung	MZVLW256HEHP 256G
	Toshiba	TSB XG4 256G
	Samsung	MZVLW512HMJP 512G
	Toshiba	TSB XG4 512G
	Samsung	MZVLW1T0HMLH-000L2 1TB
LCD	LGD	LP139UD1-SPC1
	AUO	B139HAN03.0
Adapter	Chicony	ADLX65YCC3A 20V3.25A
	Liteon	ADLX65YLC3A 20V3.25A
	Delta	ADLX65YDC3A 20V3.25A
	Acbel	ADLX65YAC3A 20V3.25A
Battery	Simplo	L16M4P60
	Celxpert	L16C4P61
WLAN	Qualcomm Atheros	QCNFA344A
Camera	BISON	BNG119VSN
	Chicony	CKFGH44
	AVC	HAA-8NC302
Active Pen (optional)	Wacom	ESP101Bxxxx，x=0~9,A-Z,a~z, for marketing use only.

5. RF Exposure Limits

5.1 Uncontrolled Environment

Uncontrolled Environments are defined as locations where there is the exposure of individuals who have no knowledge or control of their exposure. The general population/uncontrolled exposure limits are applicable to situations in which the general public may be exposed or in which persons who are exposed as a consequence of their employment may not be made fully aware of the potential for exposure or cannot exercise control over their exposure. Members of the general public would come under this category when exposure is not employment-related; for example, in the case of a wireless transmitter that exposes persons in its vicinity.

5.2 Controlled Environment

Controlled Environments are defined as locations where there is exposure that may be incurred by persons who are aware of the potential for exposure, (i.e. as a result of employment or occupation). In general, occupational/controlled exposure limits are applicable to situations in which persons are exposed as a consequence of their employment, who have been made fully aware of the potential for exposure and can exercise control over their exposure. The exposure category is also applicable when the exposure is of a transient nature due to incidental passage through a location where the exposure levels may be higher than the general population/uncontrolled limits, but the exposed person is fully aware of the potential for exposure and can exercise control over his or her exposure by leaving the area or by some other appropriate means.

Limits for Occupational/Controlled Exposure (W/kg)

Whole-Body	Partial-Body	Hands, Wrists, Feet and Ankles
0.4	8.0	20.0

Limits for General Population/Uncontrolled Exposure (W/kg)

Whole-Body	Partial-Body	Hands, Wrists, Feet and Ankles
0.08	1.6	4.0

Whole-Body SAR is averaged over the entire body, partial-body SAR is averaged over any 1gram of tissue defined as a tissue volume in the shape of a cube. SAR for hands, wrists, feet and ankles is averaged over any 10 grams of tissue defined as a tissue volume in the shape of a cube.

6. Specific Absorption Rate (SAR)

6.1 Introduction

SAR is related to the rate at which energy is absorbed per unit mass in an object exposed to a radio field. The SAR distribution in a biological body is complicated and is usually carried out by experimental techniques or numerical modeling. The standard recommends limits for two tiers of groups, occupational/controlled and general population/uncontrolled, based on a person's awareness and ability to exercise control over his or her exposure. In general, occupational/controlled exposure limits are higher than the limits for general population/uncontrolled.

6.2 SAR Definition

The SAR definition is the time derivative (rate) of the incremental energy (dW) absorbed by (dissipated in) an incremental mass (dm) contained in a volume element (dv) of a given density (ρ). The equation description is as below:

$$\mathbf{SAR} = \frac{\mathbf{d}}{\mathbf{dt}}\left(\frac{\mathbf{dW}}{\mathbf{dm}}\right) = \frac{\mathbf{d}}{\mathbf{dt}}\left(\frac{\mathbf{dW}}{\boldsymbol{\rho}\mathbf{dv}}\right)$$

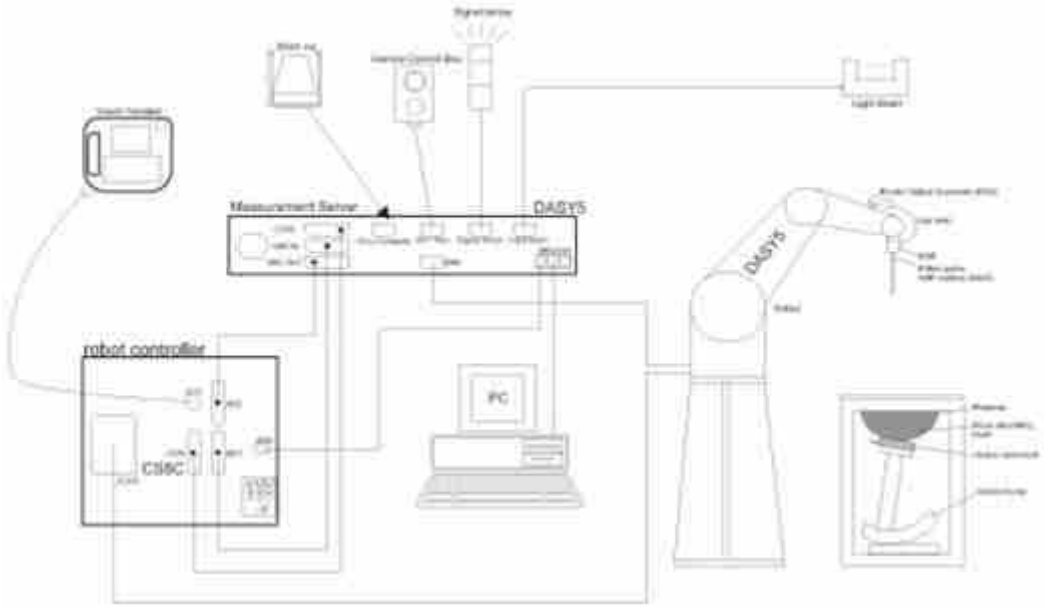
SAR is expressed in units of Watts per kilogram (W/kg)

$$\mathbf{SAR} = \frac{\boldsymbol{\sigma}|\mathbf{E}|^{\mathbf{2}}}{\boldsymbol{\rho}}$$

Where: σ is the conductivity of the tissue, ρ is the mass density of the tissue and E is the RMS electrical field strength.

7. System Description and Setup

The DASY system used for performing compliance tests consists of the following items:



- A standard high precision 6-axis robot with controller, teach pendant and software. An arm extension for accommodating the data acquisition electronics (DAE).
- An isotropic Field probe optimized and calibrated for the targeted measurement.
- A data acquisition electronics (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.
- The Electro-optical converter (EOC) performs the conversion from optical to electrical signals for the digital communication to the DAE. To use optical surface detection, a special version of the EOC is required. The EOC signal is transmitted to the measurement server.
- The function of the measurement server is to perform the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
- The Light Beam used is for probe alignment. This improves the (absolute) accuracy of the probe positioning.
- A computer running WinXP or Win7 and the DASY5 software.
- Remote control and teach pendant as well as additional circuitry for robot safety such as warning lamps, etc.
- The phantom, the device holder and other accessories according to the targeted measurement.

7.1 E-Field Probe

The SAR measurement is conducted with the dosimetric probe (manufactured by SPEAG).The probe is specially designed and calibrated for use in liquid with high permittivity. The dosimetric probe has special calibration in liquid at different frequency. This probe has a built in optical surface detection system to prevent from collision with phantom.

<EX3DV4 Probe>

Construction	Symmetric design with triangular core Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)
Frequency	10 MHz – >6 GHz Linearity: ±0.2 dB (30 MHz – 6 GHz)
Directivity	±0.3 dB in TSL (rotation around probe axis) ±0.5 dB in TSL (rotation normal to probe axis)
Dynamic Range	10 µW/g – >100 mW/g Linearity: ±0.2 dB (noise: typically <1 µW/g)
Dimensions	Overall length: 337 mm (tip: 20 mm) Tip diameter: 2.5 mm (body: 12 mm) Typical distance from probe tip to dipole centers: 1 mm

7.2 Data Acquisition Electronics (DAE)

The data acquisition electronics (DAE) consists of a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16 bit AD-converter and a command decoder and control logic unit. Transmission to the measurement server is accomplished through an optical downlink for data and status information as well as an optical uplink for commands and the clock.

The input impedance of the DAE is 200 MOhm; the inputs are symmetrical and floating. Common mode rejection is above 80 dB.

Fig 5.1 Photo of DAE

7.3 Phantom

<SAM Twin Phantom>

Shell Thickness	2 ± 0.2 mm; Center ear point: 6 ± 0.2 mm
Filling Volume	Approx. 25 liters
Dimensions	Length: 1000 mm; Width: 500 mm; Height: adjustable feet
Measurement Areas	Left Hand, Right Hand, Flat Phantom

The bottom plate contains three pair of bolts for locking the device holder. The device holder positions are adjusted to the standard measurement positions in the three sections. A white cover is provided to tap the phantom during off-periods to prevent water evaporation and changes in the liquid parameters. On the phantom top, three reference markers are provided to identify the phantom position with respect to the robot.

<ELI Phantom>

Shell Thickness	2 ± 0.2 mm (sagging: <1%)
Filling Volume	Approx. 30 liters
Dimensions	Major ellipse axis: 600 mm Minor axis: 400 mm

The ELI phantom is intended for compliance testing of handheld and body-mounted wireless devices in the frequency range of 30 MHz to 6 GHz. ELI4 is fully compatible with standard and all known tissue simulating liquids.

7.4 Device Holder

<Mounting Device for Hand-Held Transmitter>

In combination with the Twin SAM V5.0/V5.0c or ELI phantoms, the Mounting Device for Hand-Held Transmitters enables rotation of the mounted transmitter device to specified spherical coordinates. At the heads, the rotation axis is at the ear opening. Transmitter devices can be easily and accurately positioned according to IEC 62209-1, IEEE 1528, FCC, or other specifications. The device holder can be locked for positioning at different phantom sections (left head, right head, flat). And upgrade kit to Mounting Device to enable easy mounting of wider devices like big smart-phones, e-books, small tablets, etc. It holds devices with width up to 140 mm.

Mounting Device for Hand-Held Transmitters

Mounting Device Adaptor for Wide-Phones

<Mounting Device for Laptops and other Body-Worn Transmitters>

The extension is lightweight and made of POM, acrylic glass and foam. It fits easily on the upper part of the mounting device in place of the phone positioned. The extension is fully compatible with the SAM Twin and ELI phantoms.

Mounting Device for Laptops

8. Measurement Procedures

The measurement procedures are as follows:

<Conducted power measurement>

(a) For WLAN/BT power measurement, use engineering software to configure EUT WLAN/BT continuously transmission, at maximum RF power in each supported wireless interface and frequency band
(b) Connect EUT RF port through RF cable to the power meter, and measure WLAN/BT output power

<SAR measurement>

(a) Use base station simulator to configure EUT WLAN/BT continuously transmission, at maximum RF power, in the highest power channel.
(b) Place the EUT in the positions as Appendix D demonstrates.
(c) Set scan area, grid size and other setting on the DASY software.
(d) Measure SAR results for the highest power channel on each testing position.
(e) Find out the largest SAR result on these testing positions of each band
(f) Measure SAR results for other channels in worst SAR testing position if the reported SAR of highest power channel is larger than 0.8 W/kg

According to the test standard, the recommended procedure for assessing the peak spatial-average SAR value consists of the following steps:

(a) Power reference measurement
(b) Area scan
(c) Zoom scan
(d) Power drift measurement

8.1 Spatial Peak SAR Evaluation

The procedure for spatial peak SAR evaluation has been implemented according to the test standard. It can be conducted for 1g and 10g, as well as for user-specific masses. The DASY software includes all numerical procedures necessary to evaluate the spatial peak SAR value.

The base for the evaluation is a "cube" measurement. The measured volume must include the 1g and 10g cubes with the highest averaged SAR values. For that purpose, the center of the measured volume is aligned to the interpolated peak SAR value of a previously performed area scan.

The entire evaluation of the spatial peak values is performed within the post-processing engine (SEMCAD). The system always gives the maximum values for the 1g and 10g cubes. The algorithm to find the cube with highest averaged SAR is divided into the following stages:

(a) Extraction of the measured data (grid and values) from the Zoom Scan
(b) Calculation of the SAR value at every measurement point based on all stored data (A/D values and measurement parameters)
(c) Generation of a high-resolution mesh within the measured volume
(d) Interpolation of all measured values form the measurement grid to the high-resolution grid
(e) Extrapolation of the entire 3-D field distribution to the phantom surface over the distance from sensor to surface
(f) Calculation of the averaged SAR within masses of 1g and 10g

8.2 Power Reference Measurement

The Power Reference Measurement and Power Drift Measurements are for monitoring the power drift of the device under test in the batch process. The minimum distance of probe sensors to surface determines the closest measurement point to phantom surface. This distance cannot be smaller than the distance of sensor calibration points to probe tip as defined in the probe properties.

8.3 Area Scan

The area scan is used as a fast scan in two dimensions to find the area of high field values, before doing a fine measurement around the hot spot. The sophisticated interpolation routines implemented in DASY software can find the maximum found in the scanned area, within a range of the global maximum. The range (in dB0 is specified in the standards for compliance testing. For example, a 2 dB range is required in IEEE standard 1528 and IEC 62209 standards, whereby 3 dB is a requirement when compliance is assessed in accordance with the ARIB standard (Japan), if only one zoom scan follows the area scan, then only the absolute maximum will be taken as reference. For cases where multiple maximums are detected, the number of zoom scans has to be increased accordingly.

Area scan parameters extracted from FCC KDB 865664 D01v01r04 SAR measurement 100 MHz to 6 GHz.

	≤ 3 GHz	> 3 GHz
Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface	5 ± 1 mm	$\frac{1}{2}\cdot\delta\cdot\ln(2) \pm 0.5$ mm
Maximum probe angle from probe axis to phantom surface normal at the measurement location	30° ± 1°	20° ± 1°
Maximum area scan spatial resolution: Δx_{Area}, Δy_{Area}	≤ 2 GHz: ≤ 15 mm 2 – 3 GHz: ≤ 12 mm	3 – 4 GHz: ≤ 12 mm 4 – 6 GHz: ≤ 10 mm
	When the x or y dimension of the test device, in the measurement plane orientation, is smaller than the above, the measurement resolution must be ≤ the corresponding x or y dimension of the test device with at least one measurement point on the test device.	

8.4 Zoom Scan

Zoom scans are used assess the peak spatial SAR values within a cubic averaging volume containing 1 gram and 10 gram of simulated tissue. The zoom scan measures points (refer to table below) within a cube shoes base faces are centered on the maxima found in a preceding area scan job within the same procedure. When the measurement is done, the zoom scan evaluates the averaged SAR for 1 gram and 10 gram and displays these values next to the job's label.

Zoom scan parameters extracted from FCC KDB 865664 D01v01r04 SAR measurement 100 MHz to 6 GHz.

			≤ 3 GHz	> 3 GHz
Maximum zoom scan spatial resolution: Δx_{Zoom}, Δy_{Zoom}			≤ 2 GHz: ≤ 8 mm 2 – 3 GHz: ≤ 5 mm*	3 – 4 GHz: ≤ 5 mm* 4 – 6 GHz: ≤ 4 mm*
Maximum zoom scan spatial resolution, normal to phantom surface	uniform grid: $\Delta z_{Zoom}(n)$		≤ 5 mm	3 – 4 GHz: ≤ 4 mm 4 – 5 GHz: ≤ 3 mm 5 – 6 GHz: ≤ 2 mm
	graded grid	$\Delta z_{Zoom}(1)$: between 1st two points closest to phantom surface	≤ 4 mm	3 – 4 GHz: ≤ 3 mm 4 – 5 GHz: ≤ 2.5 mm 5 – 6 GHz: ≤ 2 mm
		$\Delta z_{Zoom}(n>1)$: between subsequent points	≤ 1.5·$\Delta z_{Zoom}(n-1)$	
Minimum zoom scan volume	x, y, z		≥ 30 mm	3 – 4 GHz: ≥ 28 mm 4 – 5 GHz: ≥ 25 mm 5 – 6 GHz: ≥ 22 mm

Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see draft standard IEEE P1528-2011 for details.

* When zoom scan is required and the *reported* SAR from the *area scan based 1-g SAR estimation* procedures of KDB 447498 is ≤ 1.4 W/kg, ≤ 8 mm, ≤ 7 mm and ≤ 5 mm zoom scan resolution may be applied, respectively, for 2 GHz to 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz.

8.5 Volume Scan Procedures

The volume scan is used for assess overlapping SAR distributions for antennas transmitting in different frequency bands. It is equivalent to an oversized zoom scan used in standalone measurements. The measurement volume will be used to enclose all the simultaneous transmitting antennas. For antennas transmitting simultaneously in different frequency bands, the volume scan is measured separately in each frequency band. In order to sum correctly to compute the 1g aggregate SAR, the EUT remain in the same test position for all measurements and all volume scan use the same spatial resolution and grid spacing. When all volume scan were completed, the software, SEMCAD postprocessor can combine and subsequently superpose these measurement data to calculating the multiband SAR.

8.6 Power Drift Monitoring

All SAR testing is under the EUT install full charged battery and transmit maximum output power. In DASY measurement software, the power reference measurement and power drift measurement procedures are used for monitoring the power drift of EUT during SAR test. Both these procedures measure the field at a specified reference position before and after the SAR testing. The software will calculate the field difference in dB. If the power drifts more than 5%, the SAR will be retested.

9. Test Equipment List

Manufacturer	Name of Equipment	Type/Model	Serial Number	Calibration	
				Last Cal.	Due Date
SPEAG	2450MHz System Validation Kit	D2450V2	840	2016/11/25	2017/11/24
SPEAG	5000MHz System Validation Kit	D5GHzV2	1113	2016/12/13	2017/12/12
SPEAG	Data Acquisition Electronics	DAE4	1210	2017/5/25	2018/5/24
SPEAG	Dosimetric E-Field Probe	EX3DV4	3857	2017/5/26	2018/5/25
SPEAG	Phone Positioner	N/A	N/A	NCR	NCR
SPEAG	ELI4 Phantom	QD OVA 001 BB	TP-1127	NCR	NCR
Agilent	ENA Series Network Analyzer	E5071C	MY46111157	2017/4/18	2018/4/17
SPEAG	DAK Kit	DAK3.5	1144	2016/11/23	2017/11/22
R&S	Signal Generator	SMR40	100455	2017/1/19	2018/1/18
R&S	CBT BLUETOOTH TESTER	CBT	101137	2016/8/9	2017/8/8
Anritsu	Power Senor	MA2411B	1644003	2016/12/23	2017/12/22
Anritsu	Power Meter	ML2495A	1531197	2016/12/23	2017/12/22
Anritsu	Power Senor	MA2411B	1644004	2016/12/23	2017/12/22
Anritsu	Power Meter	ML2495A	1531198	2016/12/23	2017/12/22
R&S	Spectrum Analyzer	FSV7	101631	2016/8/8	2017/8/7
WISEWIND	Hygrometer	WISEWIND 0905	0905	2017/4/20	2018/4/19
JM	DIGITAC THERMOMETER	JM222	AA1207166	2017/4/19	2018/4/18
ARRA	Power Divider	A3200-2	NA	Note	
Agilent	Dual Directional Coupler	778D	50422	Note	
PASTERNACK	Dual Directional Coupler	PE2214-10	N/A	Note	
AR	Amplifier	5S1G4	333096	Note	
mini-circuits	Amplifier	ZVE-3W-83+	162601250	Note	
MCL	Attenuation1	BW-S10W5+	N/A	Note	
MCL	Attenuation2	BW-S10W5+	N/A	Note	
MCL	Attenuation3	BW-S10W5+	N/A	Note	

Note:
Prior to system verification and validation, the path loss from the signal generator to the system check source and the power meter, which includes the amplifier, cable, attenuator and directional coupler, was measured by the network analyzer. The reading of the power meter was offset by the path loss difference between the path to the power meter and the path to the system check source to monitor the actual power level fed to the system check source.

10. System Verification

10.1 Tissue Simulating Liquids

For the measurement of the field distribution inside the SAM phantom with DASY, the phantom must be filled with around 25 liters of homogeneous body tissue simulating liquid. For body SAR testing, the liquid height from the center of the flat phantom to the liquid top surface is larger than 15 cm, which is shown in Fig. 10.1.

Fig 10.1 Photo of Liquid Height for Body SAR

10.2 Tissue Verification

The following tissue formulations are provided for reference only as some of the parameters have not been thoroughly verified. The composition of ingredients may be modified accordingly to achieve the desired target tissue parameters required for routine SAR evaluation.

Frequency (MHz)	Water (%)	Sugar (%)	Cellulose (%)	Salt (%)	Preventol (%)	DGBE (%)	Conductivity (σ)	Permittivity (εr)
For Body								
2450	68.6	0	0	0	0	31.4	1.95	52.7

Simulating Liquid for 5GHz, Manufactured by SPEAG

Ingredients	(% by weight)
Water	64~78%
Mineral oil	11~18%
Emulsifiers	9~15%
Additives and Salt	2~3%

<Tissue Dielectric Parameter Check Results>

Frequency (MHz)	Tissue Type	Liquid Temp. (℃)	Conductivity (σ)	Permittivity (ε_r)	Conductivity Target (σ)	Permittivity Target (ε_r)	Delta (σ) (%)	Delta (ε_r) (%)	Limit (%)	Date
2450	Body	22.5	1.987	51.883	1.95	52.70	1.90	-1.55	±5	2017/6/25
5250	Body	22.6	5.354	48.459	5.36	48.90	-0.11	-0.90	±5	2017/6/26
5600	Body	22.7	5.849	47.666	5.77	48.50	1.37	-1.72	±5	2017/6/28
5750	Body	22.8	6.058	47.348	5.94	48.30	1.99	-1.97	±5	2017/6/30

10.3 System Performance Check Results

Comparing to the original SAR value provided by SPEAG, the verification data should be within its specification of 10 %. Below table shows the target SAR and measured SAR after normalized to 1W input power. The table below indicates the system performance check can meet the variation criterion and the plots can be referred to Appendix A of this report.

Date	Frequency (MHz)	Tissue Type	Input Power (mW)	Dipole S/N	Probe S/N	DAE S/N	Measured SAR (W/kg)	Targeted SAR (W/kg)	Normalized SAR (W/kg)	Deviation (%)
2017/6/25	2450	Body	250	840	3857	1210	12.10	50.90	48.4	-4.91
2017/6/26	5250	Body	100	1113	3857	1210	7.49	76.10	74.9	-1.58
2017/6/28	5600	Body	100	1113	3857	1210	7.78	79.80	77.8	-2.51
2017/6/30	5750	Body	100	1113	3857	1210	7.33	75.20	73.3	-2.53

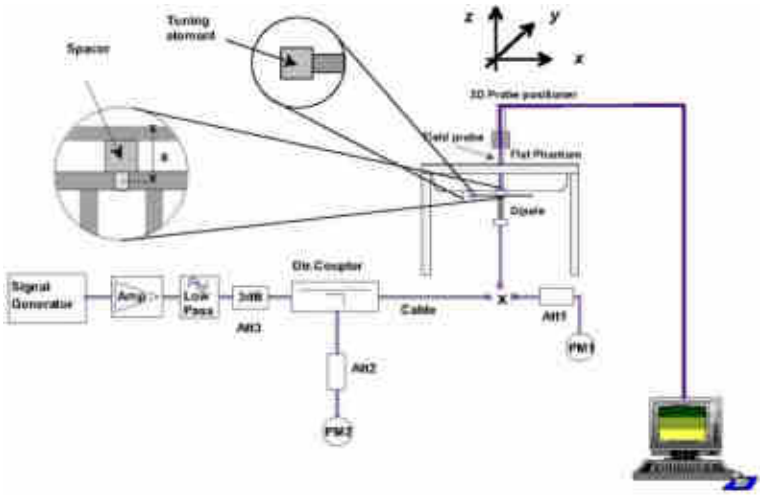


Fig 8.3.1 System Performance Check Setup

Fig 8.3.2 Setup Photo

11. RF Exposure Positions

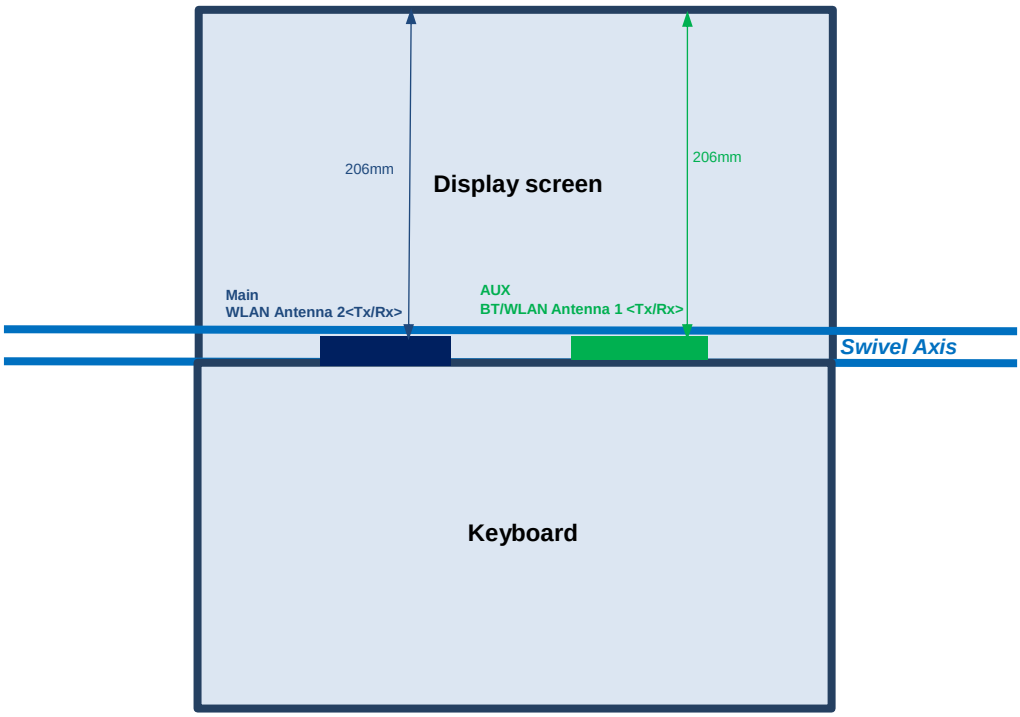
This DUT has two typical use conditions which are notebook mode and tablet mode, so the DUT were tested in Bottom and Back of Panel were tested for notebook mode; Bottom Face and Edge 3 for tablet mode.

<EUT Setup Photos>

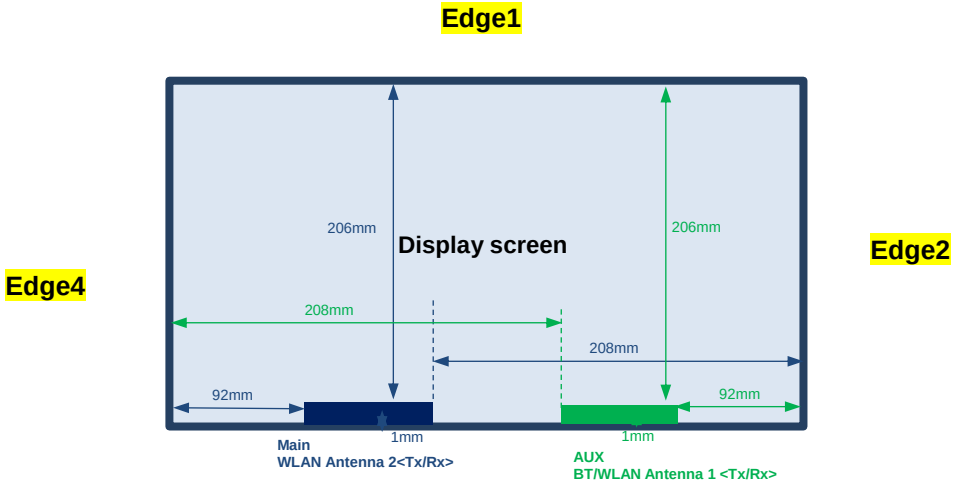
Please refer to Appendix D for the test setup photos.

12. Antenna Location

<Notebook Mode>



<Tablet Mode>



Diagonal Dimension: 386mm

Front View

General Note:

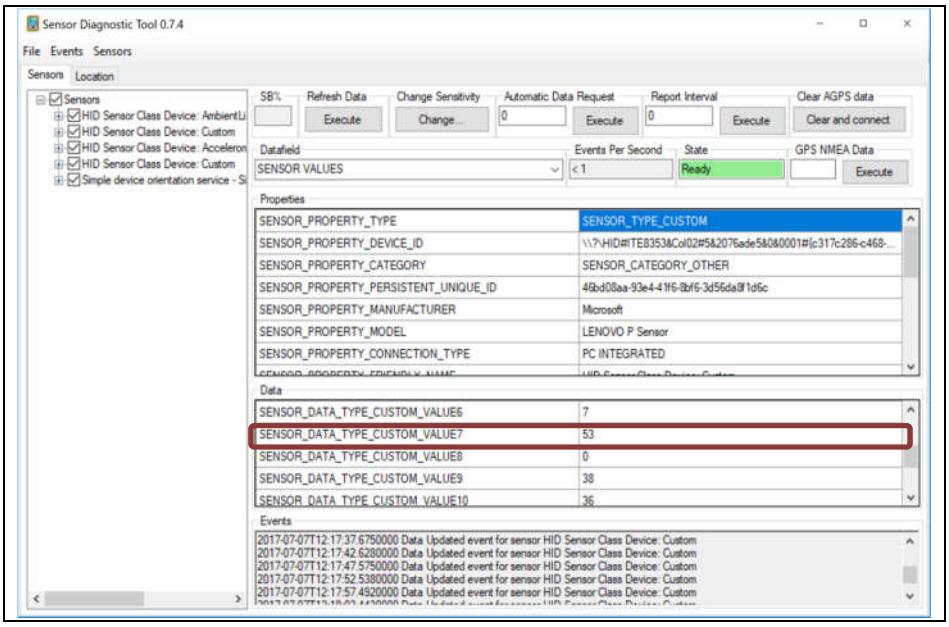
1. The below table, when the distance is < 50 mm exclusion threshold is "Ratio", when the distance is > 50 mm exclusion threshold is "mW"
2. Maximum power is the source-based time-average power and represents the maximum RF output power among production units
3. Per KDB 447498 D01v06, for larger devices, the test separation distance of adjacent edge configuration is determined by the closest separation between the antenna and the user.
4. Per KDB 447498 D01v06, standalone SAR test exclusion threshold is applied; If the test separation distance is < 5mm, 5mm is used to determine SAR exclusion threshold.
5. Per KDB 447498 D01v06, the 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at *test separation distances* ≤ 50 mm are determined by:
   [(*max. power of channel, including tune-up tolerance, mW*)/(*min. test separation distance, mm*)] ·[√f(GHz)] ≤ 3.0 for 1-g SAR and ≤ 7.5 for 10-g extremity SAR
   - f(GHz) is the RF channel transmit frequency in GHz
   - Power and distance are rounded to the nearest mW and mm before calculation
   - The result is rounded to one decimal place for comparison
6. Per KDB 447498 D01v06, at 100 MHz to 6 GHz and for *test separation distances* > 50 mm, the SAR test exclusion threshold is determined according to the following
   a) [Threshold at 50 mm in step 1) + (test separation distance - 50 mm)·(f(MHz)/150)] mW, at 100 MHz to 1500 MHz
   b) [Threshold at 50 mm in step 1) + (test separation distance - 50 mm)·10] mW at > 1500 MHz and ≤ 6 GHz

Exposure Position	Wireless Interface	Bluetooth	2.4GHz WLAN Ant.1	2.4GHz WLAN Ant.2	5GHz WLAN Ant.1	5GHz WLAN Ant.2
	Calculated Frequency	2480MHz	2462MHz	2462MHz	5825MHz	5825MHz
	Maximum power (dBm)	8.5	20.5	20.5	15	15
	Maximum rated power(mW)	7.0	112.0	112.0	32.0	32.0
Bottom Face	Separation distance(mm)	0	0	0	0	0
	exclusion threshold	2.2	35.2	35.2	15.5	15.5
	Testing required?	No	Yes	Yes	Yes	Yes
Edge 1	Separation distance(mm)	206.0	206.0	206.0	206.0	206.0
	exclusion threshold	1655.0	1656.0	1656.0	1622.0	1622.0
	Testing required?	No	No	No	No	No
Edge 2	Separation distance(mm)	92.0	92.0	208.0	92.0	208.0
	exclusion threshold	515.0	516.0	1676.0	482.0	1642.0
	Testing required?	No	No	No	No	No
Edge 3	Separation distance(mm)	1.0	1.0	1.0	1.0	1.0
	exclusion threshold	2.2	35.2	35.2	15.5	15.5
	Testing required?	No	Yes	Yes	Yes	Yes
Edge 4	Separation distance(mm)	208.0	208.0	92.0	208.0	92.0
	exclusion threshold	1675.0	1676.0	516.0	1642.0	482.0
	Testing required?	No	No	No	No	No
Bottom	Separation distance(mm)	0	0	0	0	0
	exclusion threshold	2.2	35.2	35.2	15.5	15.5
	Testing required?	No	Yes	Yes	Yes	Yes

13. Analysis of Proximity Sensoring

A proximity sensor for power reduction is implemented in this device to address RF exposure compliance when the Wi-Fi antenna is positioned close to the user's body. The sensor's mechanical structure is designed to fit within the enclosure design used in this device and also extended around the edge and rear of the antenna element in order to optimize sensitivity in these orientations.

The power reduction by proximity sensor triggering, test software 'Microsoft Sensor Diagnostic Tool' will represent corresponding 'Sensor Data Type Custom value7 or value 8' value for different power levels declared by manufacturer; for example, 'Sensor Data Type Custom value7' value 53 (as shown below) represents the P-sensor triggered power reduction reduced power for tablet mode at Edge 3 distance 0~9mm.



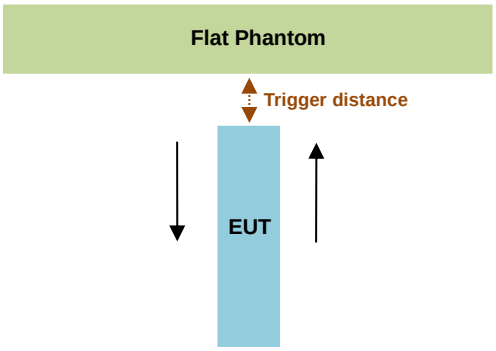
Proximity Sensor Operating Status

Triggering Configurations								
Band	Notebook Mode				Tablet Mode			
	Position	Distance	Power	Sensor Data Type Custom Value Range	Position	Distance	Power	Sensor Data Type Custom Value Range
2.4GHz WLAN	Bottom	≥8mm	Full Power	0~1	Bottom Face	≥6mm	Full Power	0-4
	Bottom	0~7mm	Reduced Power	≥2	Bottom Face	0~5mm	Reduced Power	≥5
					Edge 3	≥10mm	Full Power	0~4
					Edge 3	0~9mm	Reduced Power	≥5
5GHz WLAN	Bottom	≥8mm	Full Power	0~1	Bottom Face	≥6mm	Full Power	0~4
	Bottom	0~7mm	Reduced Power	≥2	Bottom Face	0~5mm	Reduced Power	≥5
					Edge 3	≥10mm	Full Power	0~4
					Edge 3	0~9mm	Reduced Power	≥5

Remark: There are two P-sensors in this device making reduce power more reliable, these two sensors are identical, the TX antenna and sensor pad also are identical, the distance between the two sensor pad and device edge side and bottom face is identical, each one connect one antenna to detect the distance from antenna to human body, the power will be reduced regardless of which sensor is triggered at SISO and MIMO mode. If both sensors be simultaneous triggered, the device will choose lower power to set both two antenna. When the device detected sensor failure and malfunctioning, the default power level is lower power level.

13.1 Proximity Sensor Triggering Distances

Proximity sensor triggering distance testing was performed according to the procedures outlined in KDB 616217 D04 section 6.2, and EUT moving further away from the flat phantom and EUT moving toward the flat phantom were both assessed. The details are illustrated in the exhibit “P-Sensor operational description”, and the shortest triggering distances were reported and used for SAR assessment.
In the preliminary triggering distance testing, the tissue-equivalent medium for different frequency bands were used for verification; no other frequency bands tissue-equivalent medium was found to result in shortest triggering distance, and the tissue-equivalent medium was used for formal proximity sensor triggering testing.



<Moved Towards the Phantom>

Notebook Mode		
EUT to Phantom Distance (mm)	Bottom Proximity Sensor Status	
	Trigger Power Level	Sensor Data Type Custom Value Range
30	Full Power	0~1
27	Full Power	0~1
24	Full Power	0~1
21	Full Power	0~1
18	Full Power	0~1
15	Full Power	0~1
12	Full Power	0~1
11	Full Power	0~1
10	Full Power	0~1
9	Full Power	0~1
8	Full Power	0~1
7	Reduced Power	≥2
6	Reduced Power	≥2
5	Reduced Power	≥2
4	Reduced Power	≥2
3	Reduced Power	≥2
2	Reduced Power	≥2
1	Reduced Power	≥2
0	Reduced Power	≥2

Tablet Mode				
EUT to Phantom Distance (mm)	Bottom Face Proximity Sensor Status		Edge 3 Proximity Sensor Status	
	Trigger Power Level	Sensor Data Type Custom Value Range	Trigger Power Level	Sensor Data Type Custom Value Range
30	Full Power	0~4	Full Power	0~4
27	Full Power	0~4	Full Power	0~4
24	Full Power	0~4	Full Power	0~4
21	Full Power	0~4	Full Power	0~4
18	Full Power	0~4	Full Power	0~4
15	Full Power	0~4	Full Power	0~4
12	Full Power	0~4	Full Power	0~4
11	Full Power	0~4	Full Power	0~4
10	Full Power	0~4	Full Power	0~4
9	Full Power	0~4	Reduced Power	≥5
8	Full Power	0~4	Reduced Power	≥5
7	Full Power	0~4	Reduced Power	≥5
6	Full Power	0~4	Reduced Power	≥5
5	Reduced Power	≥5	Reduced Power	≥5
4	Reduced Power	≥5	Reduced Power	≥5
3	Reduced Power	≥5	Reduced Power	≥5
2	Reduced Power	≥5	Reduced Power	≥5
1	Reduced Power	≥5	Reduced Power	≥5
0	Reduced Power	≥5	Reduced Power	≥5

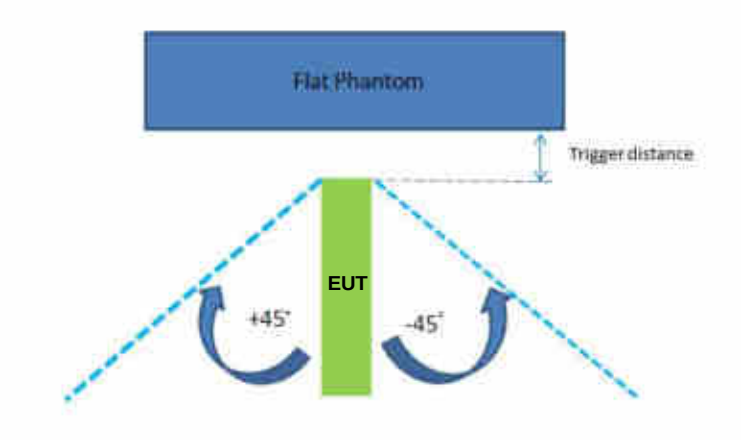
<Moved Away from the Phantom>

Notebook Mode		
EUT to Phantom Distance (mm)	Bottom Proximity Sensor Status	
	Trigger Power Level	Sensor Data Type Custom Value Range
0	Reduced Power	≥2
1	Reduced Power	≥2
2	Reduced Power	≥2
3	Reduced Power	≥2
4	Reduced Power	≥2
5	Reduced Power	≥2
6	Reduced Power	≥2
7	Reduced Power	≥2
8	Full Power	0~1
9	Full Power	0~1
10	Full Power	0~1
11	Full Power	0~1
12	Full Power	0~1
15	Full Power	0~1
18	Full Power	0~1
21	Full Power	0~1
24	Full Power	0~1
27	Full Power	0~1
30	Full Power	0~1

Tablet Mode				
EUT to Phantom Distance (mm)	Bottom Face Proximity Sensor Status		Edge 3 Proximity Sensor Status	
	Trigger Power Level	Sensor Data Type Custom Value Range	Trigger Power Level	Sensor Data Type Custom Value Range
0	Reduced Power	≥5	Reduced Power	≥5
1	Reduced Power	≥5	Reduced Power	≥5
2	Reduced Power	≥5	Reduced Power	≥5
3	Reduced Power	≥5	Reduced Power	≥5
4	Reduced Power	≥5	Reduced Power	≥5
5	Reduced Power	≥5	Reduced Power	≥5
6	Full Power	0~4	Reduced Power	≥5
7	Full Power	0~4	Reduced Power	≥5
8	Full Power	0~4	Reduced Power	≥5
9	Full Power	0~4	Reduced Power	≥5
10	Full Power	0~4	Full Power	0~4
11	Full Power	0~4	Full Power	0~4
12	Full Power	0~4	Full Power	0~4
15	Full Power	0~4	Full Power	0~4
18	Full Power	0~4	Full Power	0~4
21	Full Power	0~4	Full Power	0~4
24	Full Power	0~4	Full Power	0~4
27	Full Power	0~4	Full Power	0~4
30	Full Power	0~4	Full Power	0~4

13.2 Tablet Tilt Angle Influences to Proximity Sensor Triggering

The influence of table tilt angles to proximity sensor triggering was determined by positioning each tablet edge that contains a transmitting antenna, perpendicular to the flat phantom.
Rotating the tablet around the edge next to the phantom in ≤ 10° increments until the tablet is ± 45° from the vertical position at 0°, and the maximum output power remains in the reduced mode.



Proximity Sensor Trigger Distance (mm)	
Mode	Tablet
Position	Edge 3
Minimum	10

13.3 Proximity Sensor Triggering Coverage

If a sensor is spatially offset from the antenna(s), it is necessary to verify sensor triggering for conditions where the antenna is next to the user but the sensor is laterally further away to ensure sensor coverage is sufficient for reducing the power to maintain compliance. For p-sensor coverage testing, the device is moved and “along the direction of maximum antenna and sensor offset”.
Illustrated in the internal photo exhibit, although the senor is spatially offset, there is no trigger condition where the antenna is next to the user but the sensor is laterally further away, therefore proximity sensor coverage testing is not required.
This procedure is not required because antenna and sensor are collocated and the peak SAR location is overlapping with the sensor.

13.4 Proximity Sensor SAR Test Configurations

Test configurations	Proximity Sensor SAR Required	Remark
Notebook Bottom	Yes	
Tablet Bottom Face	Yes	
Edge 3	Yes	
Edge 1	No	Due to proximity sensor and Wi-Fi antenna is far away from the edges, and there’s no sensor coverage, so power reduced and normal power SAR is not needed.
Edge 2	No	
Edge 4	No	

14. Conducted RF Output Power (Unit: dBm)

14.1 Maximum Tune-up Power

<Wi-Fi 2x2Tx Single Chain>

<2.4GHz WLAN Ant.1>

2.4GHz WLAN Ant.1							
Mode	Ch.	Fre. (MHz)	Data Rate	Tune-up power (dBm)			
				Notebook Mode		Tablet Mode	
				Full Power	Reduced Power	Full Power	Reduced Power
802.11b	1	2412	1Mbps	20.50	15.00	20.50	15.00
	6	2437		20.50	15.00	20.50	15.00
	11	2462		20.50	15.00	20.50	15.00
802.11g	1	2412	6Mbps	18.00	15.00	18.00	15.00
	6	2437		19.50	15.00	19.50	15.00
	11	2462		18.00	15.00	18.00	15.00
802.11n-HT20	1	2412	MCS0	16.00	15.00	16.00	15.00
	6	2437		19.50	15.00	19.50	15.00
	11	2462		16.00	15.00	16.00	15.00
802.11n-HT40	3	2422	MCS0	13.00	13.00	13.00	13.00
	6	2437		18.50	15.00	18.50	15.00
	9	2452		11.00	11.00	11.00	11.00
802.11ac-VHT20	1	2412	MCS0	16.00	15.00	16.00	15.00
	6	2437		19.50	15.00	19.50	15.00
	11	2462		16.00	15.00	16.00	15.00
802.11ac-VHT40	3	2422	MCS0	13.00	13.00	13.00	13.00
	6	2437		18.50	15.00	18.50	15.00
	9	2452		11.00	11.00	11.00	11.00

<2.4GHz WLAN Ant.2>

2.4GHz WLAN Ant.2							
Mode	Ch.	Fre. (MHz)	Data Rate	Tune-up power (dBm)			
				Notebook Mode		Tablet Mode	
				Full Power	Reduced Power	Full Power	Reduced Power
802.11b	1	2412	1Mbps	20.50	15.00	20.50	15.00
	6	2437		20.50	15.00	20.50	15.00
	11	2462		20.50	15.00	20.50	15.00
802.11g	1	2412	6Mbps	18.00	15.00	18.00	15.00
	6	2437		19.50	15.00	19.50	15.00
	11	2462		18.00	15.00	18.00	15.00
802.11n-HT20	1	2412	MCS0	16.00	15.00	16.00	15.00
	6	2437		19.50	15.00	19.50	15.00
	11	2462		16.00	15.00	16.00	15.00
802.11n-HT40	3	2422	MCS0	13.00	13.00	13.00	13.00
	6	2437		18.50	15.00	18.50	15.00
	9	2452		11.00	11.00	11.00	11.00
802.11ac-VHT20	1	2412	MCS0	16.00	15.00	16.00	15.00
	6	2437		19.50	15.00	19.50	15.00
	11	2462		16.00	15.00	16.00	15.00
802.11ac-VHT40	3	2422	MCS0	13.00	13.00	13.00	13.00
	6	2437		18.50	15.00	18.50	15.00
	9	2452		11.00	11.00	11.00	11.00

<5GHz WLAN Ant.1>

5.2GHz WLAN Ant.1							
Mode	Ch.	Fre. (MHz)	Data Rate	Tune-up power (dBm)			
				Notebook Mode		Tablet Mode	
				Full Power	Reduced Power	Full Power	Reduced Power
802.11a	36	5180	6Mbps	15.00	9.00	15.00	6.50
	40	5200		15.00	9.00	15.00	6.50
	44	5220		15.00	9.00	15.00	6.50
	48	5240		15.00	9.00	15.00	6.50
802.11n-HT20	36	5180	MCS0	15.00	9.00	15.00	6.50
	40	5200		15.00	9.00	15.00	6.50
	44	5220		15.00	9.00	15.00	6.50
	48	5240		15.00	9.00	15.00	6.50
802.11n-HT40	38	5190	MCS0	11.50	9.00	11.50	6.50
	46	5230		14.50	9.00	14.50	6.50
802.11ac-VHT20	36	5180	MCS0	15.00	9.00	15.00	6.50
	40	5200		15.00	9.00	15.00	6.50
	44	5220		15.00	9.00	15.00	6.50
	48	5240		15.00	9.00	15.00	6.50
802.11ac-VHT40	38	5190	MCS0	11.00	9.00	11.00	6.50
	46	5230		14.50	9.00	14.50	6.50
802.11ac-VHT80	42	5210	MCS0	10.50	9.00	10.50	6.50

5.3GHz WLAN Ant.1							
Mode	Ch.	Fre. (MHz)	Data Rate	Tune-up power (dBm)			
				Notebook Mode		Tablet Mode	
				Full Power	Reduced Power	Full Power	Reduced Power
802.11a	52	5260	6Mbps	15.00	9.00	15.00	6.50
	56	5280		15.00	9.00	15.00	6.50
	60	5300		15.00	9.00	15.00	6.50
	64	5320		15.00	9.00	15.00	6.50
802.11n-HT20	52	5260	MCS0	15.00	9.00	15.00	6.50
	56	5280		15.00	9.00	15.00	6.50
	60	5300		15.00	9.00	15.00	6.50
	64	5320		15.00	9.00	15.00	6.50
802.11n-HT40	54	5270	MCS0	14.50	9.00	14.50	6.50
	62	5310		12.50	9.00	12.50	6.50
802.11ac-VHT20	52	5260	MCS0	15.00	9.00	15.00	6.50
	56	5280		15.00	9.00	15.00	6.50
	60	5300		15.00	9.00	15.00	6.50
	64	5320		15.00	9.00	15.00	6.50
802.11ac-VHT40	54	5270	MCS0	14.50	9.00	14.50	6.50
	62	5310		12.50	9.00	12.50	6.50
802.11ac-VHT80	58	5290	MCS0	11.00	9.00	11.00	6.50

5.5GHz WLAN Ant.1							
Mode	Ch.	Fre. (MHz)	Data Rate	Tune-up power (dBm)			
				Notebook Mode		Tablet Mode	
				Full Power	Reduced Power	Full Power	Reduced Power
802.11a	100	5500	6Mbps	15.00	9.00	15.00	6.00
	108	5540		15.00	9.00	15.00	6.00
	116	5580		15.00	9.00	15.00	6.00
	132	5660		15.00	9.00	15.00	6.00
	136	5680		15.00	9.00	15.00	6.00
	140	5700		15.00	9.00	15.00	6.00
	144	5720		15.00	9.00	15.00	6.00
802.11n-HT20	100	5500	MCS0	15.00	9.00	15.00	6.00
	108	5540		15.00	9.00	15.00	6.00
	116	5580		15.00	9.00	15.00	6.00
	132	5660		15.00	9.00	15.00	6.00
	136	5680		15.00	9.00	15.00	6.00
	140	5700		15.00	9.00	15.00	6.00
	144	5720		15.00	9.00	15.00	6.00
802.11n-HT40	102	5510	MCS0	11.00	9.00	11.00	6.00
	110	5550		14.50	9.00	14.50	6.00
	126	5630		14.50	9.00	14.50	6.00
	134	5670		14.50	9.00	14.50	6.00
	142	5710		14.50	9.00	14.50	6.00
802.11ac-VHT20	100	5500	MCS0	15.00	9.00	15.00	6.00
	108	5540		15.00	9.00	15.00	6.00
	116	5580		15.00	9.00	15.00	6.00
	132	5660		15.00	9.00	15.00	6.00
	136	5680		15.00	9.00	15.00	6.00
	140	5700		15.00	9.00	15.00	6.00
	144	5720		15.00	9.00	15.00	6.00
802.11ac-VHT40	102	5510	MCS0	11.00	9.00	11.00	6.00
	110	5550		14.50	9.00	14.50	6.00
	126	5630		14.50	9.00	14.50	6.00
	134	5670		14.50	9.00	14.50	6.00
	142	5710		14.50	9.00	14.50	6.00
802.11ac-VHT80	106	5530	MCS0	10.50	9.00	10.50	6.00
	122	5610		14.50	9.00	14.50	6.00
	138	5690		14.50	9.00	14.50	6.00

5.8GHz WLAN Ant.1							
Mode	Ch.	Fre. (MHz)	Data Rate	Tune-up power (dBm)			
				Notebook Mode		Tablet Mode	
				Full Power	Reduced Power	Full Power	Reduced Power
802.11a	149	5745	6Mbps	14.00	9.00	14.00	5.50
	157	5785		15.00	9.00	15.00	5.50
	165	5825		15.00	9.00	15.00	5.50
802.11n-HT20	149	5745	MCS0	12.50	9.00	12.50	5.50
	157	5785		15.00	9.00	15.00	5.50
	165	5825		15.00	9.00	15.00	5.50
802.11n-HT40	151	5755	MCS0	11.00	9.00	11.00	5.50
	159	5795		14.50	9.00	14.50	5.50
802.11ac-VHT20	149	5745	MCS0	12.50	9.00	12.50	5.50
	157	5785		15.00	9.00	15.00	5.50
	165	5825		15.00	9.00	15.00	5.50
802.11ac-VHT40	151	5755	MCS0	11.00	9.00	11.00	5.50
	159	5795		14.50	9.00	14.50	5.50
802.11ac-VHT80	155	5775	MCS0	8.50	8.50	8.50	5.50

<5GHz WLAN Ant.2>

5.2GHz WLAN Ant.2							
Mode	Ch.	Fre. (MHz)	Data Rate	Tune-up power (dBm)			
				Notebook Mode		Tablet Mode	
				Full Power	Reduced Power	Full Power	Reduced Power
802.11a	36	5180	6Mbps	15.00	9.00	15.00	6.50
	40	5200		15.00	9.00	15.00	6.50
	44	5220		15.00	9.00	15.00	6.50
	48	5240		15.00	9.00	15.00	6.50
802.11n-HT20	36	5180	MCS0	15.00	9.00	15.00	6.50
	40	5200		15.00	9.00	15.00	6.50
	44	5220		15.00	9.00	15.00	6.50
	48	5240		15.00	9.00	15.00	6.50
802.11n-HT40	38	5190	MCS0	11.50	9.00	11.50	6.50
	46	5230		14.50	9.00	14.50	6.50
802.11ac-VHT20	36	5180	MCS0	15.00	9.00	15.00	6.50
	40	5200		15.00	9.00	15.00	6.50
	44	5220		15.00	9.00	15.00	6.50
	48	5240		15.00	9.00	15.00	6.50
802.11ac-VHT40	38	5190	MCS0	11.00	9.00	11.00	6.50
	46	5230		14.50	9.00	14.50	6.50
802.11ac-VHT80	42	5210	MCS0	10.50	9.00	10.50	6.50

5.3GHz WLAN Ant.2							
Mode	Ch.	Fre. (MHz)	Data Rate	Tune-up power (dBm)			
				Notebook Mode		Tablet Mode	
				Full Power	Reduced Power	Full Power	Reduced Power
802.11a	52	5260	6Mbps	15.00	9.00	15.00	6.50
	56	5280		15.00	9.00	15.00	6.50
	60	5300		15.00	9.00	15.00	6.50
	64	5320		15.00	9.00	15.00	6.50
802.11n-HT20	52	5260	MCS0	15.00	9.00	15.00	6.50
	56	5280		15.00	9.00	15.00	6.50
	60	5300		15.00	9.00	15.00	6.50
	64	5320		15.00	9.00	15.00	6.50
802.11n-HT40	54	5270	MCS0	14.50	9.00	14.50	6.50
	62	5310		12.50	9.00	12.50	6.50
802.11ac-VHT20	52	5260	MCS0	15.00	9.00	15.00	6.50
	56	5280		15.00	9.00	15.00	6.50
	60	5300		15.00	9.00	15.00	6.50
	64	5320		15.00	9.00	15.00	6.50
802.11ac-VHT40	54	5270	MCS0	14.50	9.00	14.50	6.50
	62	5310		12.50	9.00	12.50	6.50
802.11ac-VHT80	58	5290	MCS0	11.00	9.00	11.00	6.50

5.5GHz WLAN Ant.2							
Mode	Ch.	Fre. (MHz)	Data Rate	Tune-up power (dBm)			
				Notebook Mode		Tablet Mode	
				Full Power	Reduced Power	Full Power	Reduced Power
802.11a	100	5500	6Mbps	15.00	9.00	15.00	6.00
	108	5540		15.00	9.00	15.00	6.00
	116	5580		15.00	9.00	15.00	6.00
	132	5660		15.00	9.00	15.00	6.00
	136	5680		15.00	9.00	15.00	6.00
	140	5700		15.00	9.00	15.00	6.00
	144	5720		15.00	9.00	15.00	6.00
802.11n-HT20	100	5500	MCS0	15.00	9.00	15.00	6.00
	108	5540		15.00	9.00	15.00	6.00
	116	5580		15.00	9.00	15.00	6.00
	132	5660		15.00	9.00	15.00	6.00
	136	5680		15.00	9.00	15.00	6.00
	140	5700		15.00	9.00	15.00	6.00
	144	5720		15.00	9.00	15.00	6.00
802.11n-HT40	102	5510	MCS0	11.00	9.00	11.00	6.00
	110	5550		14.50	9.00	14.50	6.00
	126	5630		14.50	9.00	14.50	6.00
	134	5670		14.50	9.00	14.50	6.00
	142	5710		14.50	9.00	14.50	6.00
802.11ac-VHT20	100	5500	MCS0	15.00	9.00	15.00	6.00
	108	5540		15.00	9.00	15.00	6.00
	116	5580		15.00	9.00	15.00	6.00
	132	5660		15.00	9.00	15.00	6.00
	136	5680		15.00	9.00	15.00	6.00
	140	5700		15.00	9.00	15.00	6.00
	144	5720		15.00	9.00	15.00	6.00
802.11ac-VHT40	102	5510	MCS0	11.00	9.00	11.00	6.00
	110	5550		14.50	9.00	14.50	6.00
	126	5630		14.50	9.00	14.50	6.00
	134	5670		14.50	9.00	14.50	6.00
	142	5710		14.50	9.00	14.50	6.00
802.11ac-VHT80	106	5530	MCS0	10.50	9.00	10.50	6.00
	122	5610		14.50	9.00	14.50	6.00
	138	5690		14.50	9.00	14.50	6.00

5.8GHz WLAN Ant.2							
Mode	Ch.	Fre. (MHz)	Data Rate	Tune-up power (dBm)			
				Notebook Mode		Tablet Mode	
				Full Power	Reduced Power	Full Power	Reduced Power
802.11a	149	5745	6Mbps	15.00	9.00	15.00	5.50
	157	5785		15.00	9.00	15.00	5.50
	165	5825		15.00	9.00	15.00	5.50
802.11n-HT20	149	5745	MCS0	12.50	9.00	12.50	5.50
	157	5785		15.00	9.00	15.00	5.50
	165	5825		15.00	9.00	15.00	5.50
802.11n-HT40	151	5755	MCS0	11.00	9.00	11.00	5.50
	159	5795		14.50	9.00	14.50	5.50
802.11ac-VHT20	149	5745	MCS0	12.50	9.00	12.50	5.50
	157	5785		15.00	9.00	15.00	5.50
	165	5825		15.00	9.00	15.00	5.50
802.11ac-VHT40	151	5755	MCS0	11.00	9.00	11.00	5.50
	159	5795		14.50	9.00	14.50	5.50
802.11ac-VHT80	155	5775	MCS0	8.50	8.50	8.50	5.50

Note: The power of the two chains is a calculated result from sum of the power single chain Ant.1 and single chain Ant.2.

<2.4GHz Bluetooth>

Mode	Tune-up power (dBm)
	GFSK
Bluetooth 3.0+EDR	8.5
Bluetooth v4.0/4.1 with LE	6.0

14.2 Measured Conducted Average Power

<WLAN Conducted Power>

General Note:

1. For each antenna, transmit power in SISO operation is larger than (or equal to) the power in MIMO operation, RF exposure compliance of MIMO mode can be deduced from the compliance simultaneous transmission of antennas operating in SISO mode.
2. Per KDB 248227 D01v02r02, SAR test reduction is determined according to 802.11 transmission mode configurations and certain exposure conditions with multiple test positions. In the 2.4 GHz band, separate SAR procedures are applied to DSSS and OFDM configurations to simplify DSSS test requirements. For OFDM, in both 2.4 and 5 GHz bands, an initial test configuration must be determined for each standalone and aggregated frequency band, according to the transmission mode configuration with the highest maximum output power specified for production units to perform SAR measurements. If the same highest maximum output power applies to different combinations of channel bandwidths, modulations and data rates, additional procedures are applied to determine which test configurations require SAR measurement. When applicable, an initial test position may be applied to reduce the number of SAR measurements required for next to the ear, UMPC mini-tablet or hotspot mode configurations with multiple test positions.
3. For 2.4 GHz 802.11b DSSS, either the initial test position procedure for multiple exposure test positions or the DSSS procedure for fixed exposure position is applied; these are mutually exclusive. For 2.4 GHz and 5 GHz OFDM configurations, the initial test configuration is applied to measure SAR using either the initial test position procedure for multiple exposure test position configurations or the initial test configuration procedures for fixed exposure test conditions. Based on the reported SAR of the measured configurations and maximum output power of the transmission mode configurations that are not included in the initial test configuration, the subsequent test configuration and initial test position procedures are applied to determine if SAR measurements are required for the remaining OFDM transmission configurations. In general, the number of test channels that require SAR measurement is minimized based on maximum output power measured for the test sample(s).
4. For OFDM transmission configurations in the 2.4 GHz and 5 GHz bands, When the same maximum power is specified for multiple transmission modes in a frequency band, the largest channel bandwidth, lowest order modulation, lowest data rate and lowest order 802.11a/g/n/ac mode is used for SAR measurement, on the highest measured output power channel for each frequency band.
5. DSSS and OFDM configurations are considered separately according to the required SAR procedures. SAR is measured in the initial test position using the 802.11 transmission mode configuration required by the DSSS procedure or initial test configuration and subsequent test configuration(s) according to the OFDM procedures.18 The initial test position procedure is described in the following:
   a. When the reported SAR of the initial test position is ≤ 0.4 W/kg, further SAR measurement is not required for the other test positions in that exposure configuration and 802.11 transmission mode combinations within the frequency band or aggregated band.
   b. When the reported SAR of the test position is > 0.4 W/kg, SAR is repeated for the 802.11 transmission mode configuration tested in the initial test position to measure the subsequent next closet/smallest test separation distance and maximum coupling test position on the highest maximum output power channel, until the report SAR is ≤ 0.8 W/kg or all required test position are tested.
   c. For all positions/configurations, when the reported SAR is > 0.8 W/kg, SAR is measured for these test positions/configurations on the subsequent next highest measured output power channel(s) until the reported SAR is ≤ 1.2 W/kg or all required channels are tested.

<Wi-Fi 2x2Tx Single Chain>

<2.4GHz WLAN Ant.1>

2.4GHz WLAN Ant.1											
Mode	Ch.	Fre. (MHz)	Data Rate	Average power (dBm)				Duty Cycle %			
				Notebook Mode		Tablet Mode		Notebook Mode		Tablet Mode	
				Full Power	Reduced Power	Full Power	Reduced Power	Full Power	Reduced Power	Full Power	Reduced Power
802.11b	1	2412	1Mbps	19.04	14.65	19.04	14.65	100	100	100	100
	6	2437		19.59	14.79	19.59	14.79				
	11	2462		18.58	14.77	18.58	14.77				
802.11g	1	2412	6Mbps	16.72	14.60	16.72	14.60	94.68	94.68	94.68	94.68
	6	2437		18.54	14.45	18.54	14.45				
	11	2462		16.09	14.39	16.09	14.39				
802.11n-HT20	1	2412	MCS0	14.97	14.39	14.97	14.39	94.66	94.33	94.66	94.33
	6	2437		17.80	14.69	17.80	14.69				
	11	2462		14.81	14.61	14.81	14.61				
802.11n-HT40	3	2422	MCS0	11.20	11.20	11.20	11.20	89.12	89.73	89.12	89.73
	6	2437		17.47	14.31	17.47	14.31				
	9	2452		9.01	9.01	9.01	9.01				
802.11ac-VHT20	1	2412	MCS0	15.23	14.44	15.23	14.44	94.68	94.68	94.68	94.68
	6	2437		18.09	14.72	18.09	14.72				
	11	2462		15.10	14.66	15.10	14.66				
802.11ac-VHT40	3	2422	MCS0	11.23	11.23	11.23	11.23	89.73	89.12	89.73	89.12
	6	2437		17.49	14.39	17.49	14.39				
	9	2452		9.03	9.03	9.03	9.03				

<2.4GHz WLAN Ant.2>

2.4GHz WLAN Ant.2											
Mode	Ch.	Fre. (MHz)	Data Rate	Average power (dBm)				Duty Cycle %			
				Notebook Mode		Tablet Mode		Notebook Mode		Tablet Mode	
				Full Power	Reduced Power	Full Power	Reduced Power	Full Power	Reduced Power	Full Power	Reduced Power
802.11b	1	2412	1Mbps	18.74	14.71	18.74	14.71	100	100	100	100
	6	2437		19.36	14.91	19.36	14.91				
	11	2462		18.72	14.61	18.72	14.61				
802.11g	1	2412	6Mbps	16.21	14.71	16.21	14.71	95	94.68	95	94.68
	6	2437		18.41	14.51	18.41	14.51				
	11	2462		16.28	14.66	16.28	14.66				
802.11n-HT20	1	2412	MCS0	14.32	14.32	14.32	14.51	94.66	94.66	94.66	94.66
	6	2437		17.30	14.42	17.30	14.42				
	11	2462		14.55	14.45	14.55	14.45				
802.11n-HT40	3	2422	MCS0	10.29	10.29	10.29	10.29	89.73	89.73	89.73	89.73
	6	2437		17.08	14.61	17.08	14.61				
	9	2452		8.80	8.80	8.80	8.80				
802.11ac-VHT20	1	2412	MCS0	15.02	14.57	15.02	14.57	94.68	94.33	94.68	94.33
	6	2437		17.75	14.82	17.75	14.82				
	11	2462		14.80	14.49	14.80	14.49				
802.11ac-VHT40	3	2422	MCS0	10.38	10.38	10.38	10.38	89.73	89.8	89.73	89.8
	6	2437		17.15	14.65	17.15	14.65				
	9	2452		8.89	8.89	8.89	8.89				

<5GHz WLAN Ant.1>

5.2GHz WLAN Ant.1											
Mode	Ch.	Fre. (MHz)	Data Rate	Average power (dBm)				Duty Cycle %			
				Notebook Mode		Tablet Mode		Notebook Mode		Tablet Mode	
				Full Power	Reduced Power	Full Power	Reduced Power	Full Power	Reduced Power	Full Power	Reduced Power
802.11a	36	5180	6Mbps	13.32	8.96	13.32	6.43	94.54	94.67	94.54	94.67
	40	5200		14.42	8.80	14.42	6.19				
	44	5220		14.36	8.98	14.36	6.17				
	48	5240		14.49	8.77	14.49	6.45				
802.11n-HT20	36	5180	MCS0	13.31	8.64	13.31	6.00	94.19	95	94.19	95
	40	5200		14.31	8.76	14.31	5.93				
	44	5220		14.27	8.88	14.27	6.07				
	48	5240		14.35	8.78	14.35	5.85				
802.11n-HT40	38	5190	MCS0	8.96	8.89	8.96	5.98	90.72	89.73	90.72	89.73
	46	5230		14.24	8.94	14.24	5.92				
802.11ac-VHT20	36	5180	MCS0	13.50	8.71	13.50	6.02	94.32	94.72	94.32	94.72
	40	5200		14.36	8.84	14.36	5.82				
	44	5220		14.39	8.70	14.39	5.81				
	48	5240		14.43	8.85	14.43	6.09				
802.11ac-VHT40	38	5190	MCS0	9.00	8.80	9.00	5.86	90.78	90.35	90.78	90.35
	46	5230		14.27	8.90	14.27	5.96				
802.11ac-VHT80	42	5210	MCS0	7.82	7.80	7.82	5.99	87.59	86.99	87.59	95.07

5.3GHz WLAN Ant.1											
Mode	Ch.	Fre. (MHz)	Data Rate	Average power (dBm)				Duty Cycle %			
				Notebook Mode		Tablet Mode		Notebook Mode		Tablet Mode	
				Full Power	Reduced Power	Full Power	Reduced Power	Full Power	Reduced Power	Full Power	Reduced Power
802.11a	52	5260	6Mbps	14.20	8.90	14.20	6.48	94.54	94.67	94.54	94.67
	56	5280		14.08	8.89	14.08	6.43				
	60	5300		14.34	8.84	14.34	6.23				
	64	5320		14.08	8.78	14.08	6.06				
802.11n-HT20	52	5260	MCS0	14.00	8.74	14.00	6.01	94.19	95	94.19	95
	56	5280		14.20	8.69	14.20	6.14				
	60	5300		14.18	8.66	14.18	6.09				
	64	5320		14.07	8.58	14.07	6.07				
802.11n-HT40	54	5270	MCS0	14.33	8.62	14.33	5.98	90.72	89.73	90.72	89.73
	62	5310		11.36	8.82	11.36	5.90				
802.11ac-VHT20	52	5260	MCS0	14.07	8.80	14.07	5.98	94.32	94.72	94.32	94.72
	56	5280		14.22	8.84	14.22	6.11				
	60	5300		14.24	8.86	14.24	5.81				
	64	5320		14.11	8.78	14.11	5.67				
802.11ac-VHT40	54	5270	MCS0	14.36	8.72	14.36	5.71	90.78	90.35	90.78	90.35
	62	5310		11.45	8.69	11.45	5.99				
802.11ac-VHT80	58	5290	MCS0	9.16	8.75	9.16	6.19	87.59	95.07	87.59	95.07

5.5GHz WLAN Ant.1											
Mode	Ch.	Fre. (MHz)	Data Rate	Average power (dBm)				Duty Cycle %			
				Notebook Mode		Tablet Mode		Notebook Mode		Tablet Mode	
				Full Power	Reduced Power	Full Power	Reduced Power	Full Power	Reduced Power	Full Power	Reduced Power
802.11a	100	5500	6Mbps	13.25	8.92	13.25	5.52	94.54	94.67	94.54	94.67
	108	5540		13.47	8.91	13.47	5.56				
	116	5580		13.95	8.83	13.95	5.74				
	132	5660		14.67	8.87	14.67	5.70				
	136	5680		13.48	8.77	13.48	5.62				
	140	5700		12.57	8.98	12.57	5.51				
	144	5720		14.45	8.55	14.45	5.22				
802.11n-HT20	100	5500	MCS0	12.68	8.63	12.68	5.99	94.19	95	94.19	95
	108	5540		13.23	8.77	13.23	5.97				
	116	5580		14.20	8.68	14.20	5.85				
	132	5660		13.75	8.50	13.75	5.96				
	136	5680		12.88	8.77	12.88	5.80				
	140	5700		13.32	8.87	13.32	5.97				
	144	5720		14.24	8.56	14.24	5.74				
802.11n-HT40	102	5510	MCS0	9.05	8.94	9.05	5.98	90.72	89.73	90.72	89.73
	110	5550		14.23	8.74	14.23	5.90				
	126	5630		14.35	8.98	14.35	5.83				
	134	5670		13.05	8.81	13.05	5.98				
	142	5710		14.04	8.97	14.04	5.80				
802.11ac-VHT20	100	5500	MCS0	12.76	8.76	12.76	5.99	94.32	94.72	94.32	94.72
	108	5540		13.47	8.64	13.47	5.83				
	116	5580		14.37	8.66	14.37	5.92				
	132	5660		14.29	8.85	14.29	5.71				
	136	5680		13.17	8.80	13.17	5.82				
	140	5700		13.36	8.78	13.36	5.95				
	144	5720		14.30	8.95	14.30	5.93				
802.11ac-VHT40	102	5510	MCS0	9.09	8.89	9.09	5.95	90.78	90.35	90.78	90.35
	110	5550		14.27	8.77	14.27	5.90				
	126	5630		14.38	8.61	14.38	5.80				
	134	5670		13.08	8.67	13.08	5.98				
	142	5710		14.12	8.75	14.12	5.88				
802.11ac-VHT80	106	5530	MCS0	8.96	8.85	8.96	5.41	87.59	95.07	87.59	95.07
	122	5610		13.17	8.79	13.17	5.37				
	138	5690		13.13	8.82	13.13	5.23				

5.8GHz WLAN Ant.1											
Mode	Ch.	Fre. (MHz)	Data Rate	Average power (dBm)				Duty Cycle %			
				Notebook Mode		Tablet Mode		Notebook Mode		Tablet Mode	
				Full Power	Reduced Power	Full Power	Reduced Power	Full Power	Reduced Power	Full Power	Reduced Power
802.11a	149	5745	6Mbps	12.76	8.67	12.76	5.22	94.54	94.67	94.54	94.67
	157	5785		14.40	8.96	14.40	5.19				
	165	5825		14.43	8.98	14.43	5.39				
802.11n-HT20	149	5745	MCS0	11.68	8.64	11.68	5.09	94.19	95	94.19	95
	157	5785		13.99	8.69	13.99	4.91				
	165	5825		14.07	8.79	14.07	5.03				
802.11n-HT40	151	5755	MCS0	8.63	8.63	8.63	4.98	90.72	89.73	90.72	89.73
	159	5795		13.48	8.81	13.48	4.99				
802.11ac-VHT20	149	5745	MCS0	11.70	8.76	11.70	5.10	94.32	94.72	94.32	94.72
	157	5785		14.10	8.84	14.10	4.83				
	165	5825		14.10	8.81	14.10	5.00				
802.11ac-VHT40	151	5755	MCS0	8.66	8.58	8.66	4.87	90.78	90.35	90.78	90.35
	159	5795		13.68	8.96	13.68	4.98				
802.11ac-VHT80	155	5775	MCS0	7.13	7.13	7.13	5.04	87.59	95.07	87.59	95.07

<5GHz WLAN Ant.2>

5.2GHz WLAN Ant.2											
Mode	Ch.	Fre. (MHz)	Data Rate	Average power (dBm)				Duty Cycle %			
				Notebook Mode		Tablet Mode		Notebook Mode		Tablet Mode	
				Full Power	Reduced Power	Full Power	Reduced Power	Full Power	Reduced Power	Full Power	Reduced Power
802.11a	36	5180	6Mbps	13.84	8.91	13.84	6.16	94.74	94.84	94.74	94.84
	40	5200		14.09	8.70	14.09	6.45				
	44	5220		14.27	8.75	14.27	6.37				
	48	5240		14.33	8.96	14.33	6.22				
802.11n-HT20	36	5180	MCS0	13.76	8.67	13.76	5.84	94.4	93.83	94.4	93.83
	40	5200		14.06	8.73	14.06	5.67				
	44	5220		14.02	8.50	14.02	6.00				
	48	5240		14.21	8.89	14.21	5.87				
802.11n-HT40	38	5190	MCS0	9.40	8.89	9.40	5.99	90.5	89.47	90.5	89.47
	46	5230		14.36	8.93	14.36	5.97				
802.11ac-VHT20	36	5180	MCS0	13.80	8.69	13.80	5.93	93.71	94.54	93.71	94.54
	40	5200		14.14	8.79	14.14	5.95				
	44	5220		14.09	8.86	14.09	5.89				
	48	5240		14.29	8.92	14.29	5.98				
802.11ac-VHT40	38	5190	MCS0	9.46	8.67	9.46	5.77	89.95	89.47	89.95	89.47
	46	5230		14.34	8.93	14.34	5.97				
802.11ac-VHT80	42	5210	MCS0	7.76	7.72	7.76	6.00	87.28	87.59	87.28	95.07

5.3GHz WLAN Ant.2											
Mode	Ch.	Fre. (MHz)	Data Rate	Average power (dBm)				Duty Cycle %			
				Notebook Mode		Tablet Mode		Notebook Mode		Tablet Mode	
				Full Power	Reduced Power	Full Power	Reduced Power	Full Power	Reduced Power	Full Power	Reduced Power
802.11a	52	5260	6Mbps	14.58	8.79	14.58	6.33	94.74	94.84	94.74	94.84
	56	5280		13.69	8.74	13.69	6.30				
	60	5300		14.05	8.76	14.05	6.12				
	64	5320		13.95	8.68	13.95	6.39				
802.11n-HT20	52	5260	MCS0	14.46	8.62	14.46	5.92	94.4	93.83	94.4	93.83
	56	5280		13.68	8.58	13.68	6.02				
	60	5300		14.42	8.71	14.42	5.91				
	64	5320		13.78	8.51	13.78	5.96				
802.11n-HT40	54	5270	MCS0	14.31	8.61	14.31	5.81	90.5	89.47	90.5	89.47
	62	5310		10.32	8.63	10.32	5.96				
802.11ac-VHT20	52	5260	MCS0	14.56	8.70	14.56	6.05	93.71	94.54	93.71	94.54
	56	5280		13.80	8.65	13.80	6.02				
	60	5300		14.52	8.63	14.52	5.83				
	64	5320		13.88	8.92	13.88	5.97				
802.11ac-VHT40	54	5270	MCS0	14.41	8.78	14.41	5.98	89.95	89.47	89.95	89.47
	62	5310		10.39	8.86	10.39	5.87				
802.11ac-VHT80	58	5290	MCS0	9.25	8.26	9.25	6.04	87.28	95.07	87.28	95.07

5.5GHz WLAN Ant.2											
Mode	Ch.	Fre. (MHz)	Data Rate	Average power (dBm)				Duty Cycle %			
				Notebook Mode		Tablet Mode		Notebook Mode		Tablet Mode	
				Full Power	Reduced Power	Full Power	Reduced Power	Full Power	Reduced Power	Full Power	Reduced Power
802.11a	100	5500	6Mbps	13.34	8.71	13.34	5.49	94.74	94.84	94.74	94.84
	108	5540		14.88	8.85	14.88	5.56				
	116	5580		13.26	8.94	13.26	5.45				
	132	5660		13.24	8.73	13.24	5.37				
	136	5680		14.44	8.86	14.44	5.88				
	140	5700		12.59	8.80	12.59	5.82				
	144	5720		14.17	8.45	14.17	5.27				
802.11n-HT20	100	5500	MCS0	13.33	8.57	13.33	5.87	94.4	93.83	94.4	93.83
	108	5540		14.55	8.69	14.55	5.79				
	116	5580		14.22	8.74	14.22	5.86				
	132	5660		13.78	8.55	13.78	5.96				
	136	5680		14.22	8.65	14.22	5.74				
	140	5700		13.35	8.70	13.35	5.80				
	144	5720		14.29	8.82	14.29	5.70				
802.11n-HT40	102	5510	MCS0	9.16	8.91	9.16	5.99	90.5	89.47	90.5	89.47
	110	5550		14.04	8.65	14.04	5.96				
	126	5630		14.01	8.54	14.01	5.93				
	134	5670		12.51	8.94	12.51	5.75				
	142	5710		13.79	8.95	13.79	5.86				
802.11ac-VHT20	100	5500	MCS0	13.38	8.84	13.38	5.95	93.71	94.54	93.71	94.54
	108	5540		14.61	8.68	14.61	5.79				
	116	5580		14.27	8.67	14.27	5.83				
	132	5660		14.17	8.70	14.17	5.66				
	136	5680		14.33	8.88	14.33	5.79				
	140	5700		13.53	8.68	13.53	5.81				
	144	5720		14.46	8.20	14.46	5.68				
802.11ac-VHT40	102	5510	MCS0	9.38	8.92	9.38	5.97	89.95	89.47	89.95	89.47
	110	5550		14.14	8.52	14.14	5.80				
	126	5630		14.20	8.54	14.20	5.92				
	134	5670		12.54	8.98	12.54	5.87				
	142	5710		13.93	8.75	13.93	5.90				
802.11ac-VHT80	106	5530	MCS0	9.65	8.91	9.65	5.70	87.28	95.07	87.28	95.07
	122	5610		13.40	8.86	13.40	5.51				
	138	5690		13.81	8.66	13.81	5.45				

5.8GHz WLAN Ant.2											
Mode	Ch.	Fre. (MHz)	Data Rate	Average power (dBm)				Duty Cycle %			
				Notebook Mode		Tablet Mode		Notebook Mode		Tablet Mode	
				Full Power	Reduced Power	Full Power	Reduced Power	Full Power	Reduced Power	Full Power	Reduced Power
802.11a	149	5745	6Mbps	13.31	8.84	13.31	5.12	94.74	94.84	94.74	94.84
	157	5785		14.36	8.91	14.36	5.03				
	165	5825		14.44	8.59	14.44	5.38				
802.11n-HT20	149	5745	MCS0	12.13	8.79	12.13	5.13	94.4	93.83	94.4	93.83
	157	5785		13.93	8.84	13.93	4.86				
	165	5825		14.24	8.72	14.24	5.05				
802.11n-HT40	151	5755	MCS0	9.28	8.63	9.28	4.99	90.5	89.47	90.5	89.47
	159	5795		13.34	8.90	13.34	4.87				
802.11ac-VHT20	149	5745	MCS0	12.20	8.76	12.20	5.05	93.71	94.54	93.71	94.54
	157	5785		14.23	8.90	14.23	4.79				
	165	5825		14.36	8.96	14.36	4.99				
802.11ac-VHT40	151	5755	MCS0	9.31	8.56	9.31	4.99	89.95	89.47	89.95	89.47
	159	5795		13.41	8.83	13.41	4.80				
802.11ac-VHT80	155	5775	MCS0	8.01	8.01	8.01	5.08	87.28	95.07	87.28	95.07

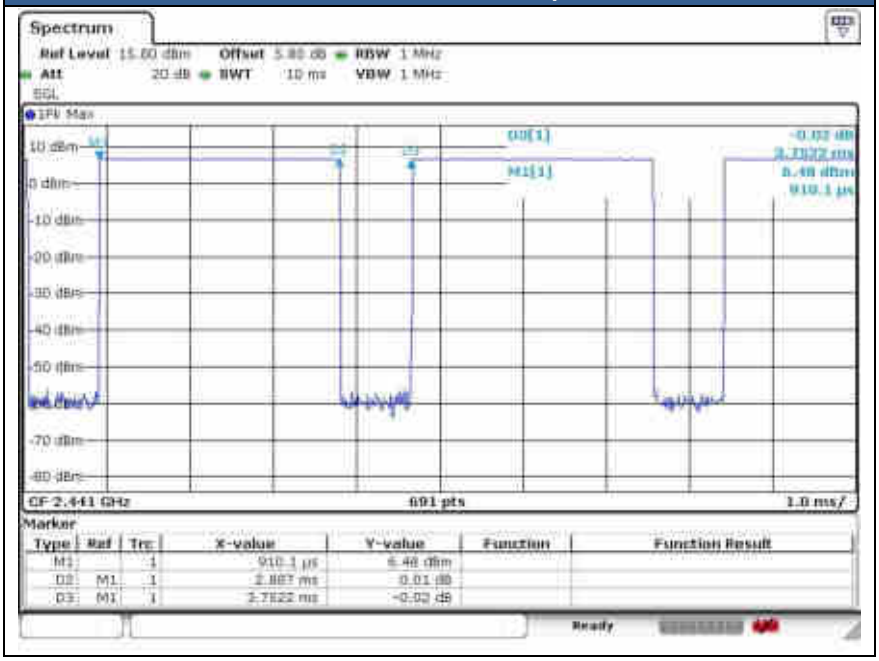
Note: The power of the two chains is a calculated result from sum of the power single chain Ant.1 and single chain Ant.2.

<2.4GHz Bluetooth>

General Note:

1. For 2.4GHz Bluetooth SAR testing was selected 1Mbps, due to its highest average power.
2. The Bluetooth duty cycle is 76.94% as following figure, according to 2016 Oct. TCB workshop for Bluetooth SAR scaling need further consideration and the theoretical duty cycle is 83.3%, therefore the actual duty cycle will be scaled up to the theoretical value of Bluetooth reported SAR calculation

Bluetooth time-domain plot



Mode	Channel	Frequency (MHz)	Average power (dBm)
			GFSK
Bluetooth v3.0+EDR	CH 00	2402	6.62
	CH 39	2441	6.95
	CH 78	2480	**7.39**

Mode	Channel	Frequency (MHz)	Average power (dBm)
			GFSK
Bluetooth v4.0/4.1 with LE	CH 00	2402	3.45
	CH 19	2440	3.75
	CH 39	2480	**3.91**

15. SAR Test Results

General Note:

1. Per KDB 447498 D01v06, the reported SAR is the measured SAR value adjusted for maximum tune-up tolerance.
   a. Tune-up scaling Factor = tune-up limit power (mW) / EUT RF power (mW), where tune-up limit is the maximum rated power among all production units.
   b. For SAR testing of WLAN signal with non-100% duty cycle, the measured SAR is scaled-up by the duty cycle scaling factor which is equal to "1/(duty cycle)"
   c. For WLAN/BT: Reported SAR(W/kg)= Measured SAR(W/kg)* Duty Cycle scaling factor * Tune-up scaling factor
2. Per KDB 447498 D01v06, for each exposure position, testing of other required channels within the operating mode of a frequency band is not required when the *reported* 1-g or 10-g SAR for the mid-band or highest output power channel is:
   - ≤ 0.8 W/kg or 2.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≤ 100 MHz
   - ≤ 0.6 W/kg or 1.5 W/kg, for 1-g or 10-g respectively, when the transmission band is between 100 MHz and 200 MHz
3. ≤ 0.4 W/kg or 1.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≥ 200 MHz
4. Per KDB 865664 D01v01r04, for each frequency band, repeated SAR measurement is required only when the measured SAR is ≥ 0.8W/kg.

Tablet Note:

1. For the exposure positions that proximity sensor power reduction is applied for SAR compliance, additional SAR testing with EUT transmitting full power in normal mode was performed.
2. Considering the curvature transition from bottom face to the edge, SAR testing at the curvature was performed. The SAR test setup is included in test setup photo exhibit, and the details of the curvature are included in operation description exhibit.
3. For SAR testing of the curved region of the device, the device was placed directly against the phantom at the point where the distance between the antenna and device exterior is a minimum.
4. When the minimum distance between antenna and device edge along the curve is less than bottom face and surface edge, the curved SAR is necessary, more detail information which can be referred to setup photo.

WLAN Note:

5. Per KDB 248227 D01v02r02, for 2.4GHz 802.11g/n SAR testing is not required when the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg.
6. Per KDB 248227 D01v02r02, U-NII-1 SAR testing is not required when the U-NII-2A band highest reported SAR for a test configuration is ≤ 1.2 W/kg, SAR is not required for U-NII-1 band.
7. When the reported SAR of the test position is > 0.4 W/kg, SAR is repeated for the 802.11 transmission mode configuration tested in the initial test position to measure the subsequent next closet/smallest test separation distance and maximum coupling test position on the highest maximum output power channel, until the report SAR is ≤ 0.8 W/kg or all required test position are tested.
8. For all positions / configurations, when the reported SAR is > 0.8 W/kg, SAR is measured for these test positions / configurations on the subsequent next highest measured output power channel(s) until the reported SAR is ≤ 1.2 W/kg or all required channels are tested.
9. For each antenna, transmit power in SISO operation is larger than (or equal to) the power in MIMO operation, RF exposure compliance of MIMO mode can be deduced from the compliance simultaneous transmission of antennas operating in SISO mode.
10. During SAR testing the WLAN transmission was verified using a spectrum analyzer.

15.1 Body SAR

<WLAN 2.4GHz SAR>

Plot No.	EUT Type	Ant. Port	Band	Mode	Test Position	Gap (mm)	Sensor	Power Reduction	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Duty Cycle %	Duty Cycle Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
	Notebook	1	WLAN 2.4GHz	802.11b 1Mbps	Bottom	7	Off	Full	6	2437	19.59	20.50	1.233	100	1.000	0.06	0.316	0.390
	Notebook	1	WLAN 2.4GHz	802.11n-HT40 MCS0	Bottom	0	On	Reduced	6	2437	14.31	15.00	1.172	89.73	1.114	0.09	0.166	0.217
	Notebook	1	WLAN 2.4GHz	802.11b 1Mbps	Back of Panel	25	Off	Full	6	2437	19.59	20.50	1.233	100	1.000	0.08	0.063	0.078
	Tablet	1	WLAN 2.4GHz	802.11b 1Mbps	Bottom Face	5	Off	Full	6	2437	19.59	20.50	1.233	100	1.000	0.05	0.236	0.291
	Tablet	1	WLAN 2.4GHz	802.11n-HT40 MCS0	Bottom Face	0	On	Reduced	6	2437	14.31	15.00	1.172	89.73	1.114	0.08	0.176	0.230
	Tablet	1	WLAN 2.4GHz	802.11b 1Mbps	Edge 3	9	Off	Full	6	2437	19.59	20.50	1.233	100	1.000	-0.02	0.250	0.308
	Tablet	1	WLAN 2.4GHz	802.11n-HT40 MCS0	Edge 3	0	On	Reduced	6	2437	14.31	15.00	1.172	89.73	1.114	-0.08	0.375	0.490
	Tablet	1	WLAN 2.4GHz	802.11n-HT40 MCS0	Curved of Edge 3	0	On	Reduced	6	2437	14.31	15.00	1.172	89.73	1.114	-0.01	0.421	0.550
	Tablet	1	WLAN 2.4GHz	802.11n-HT40 MCS0	Curved of Edge 3	0	On	Reduced	3	2422	11.20	13.00	1.514	89.73	1.114	-0.04	0.319	0.538
01	Tablet	1	WLAN 2.4GHz	802.11n-HT40 MCS0	Curved of Edge 3	0	On	Reduced	9	2452	9.01	11.00	1.581	89.73	1.114	-0.06	0.497	**0.875**
	Notebook	2	WLAN 2.4GHz	802.11b 1Mbps	Bottom	7	Off	Full	6	2437	19.36	20.50	1.300	100	1.000	0.07	0.437	0.568
	Notebook	2	WLAN 2.4GHz	802.11n-HT40 MCS0	Bottom	0	On	Reduced	6	2437	14.61	15.00	1.094	89.73	1.114	-0.16	0.289	0.352
	Notebook	2	WLAN 2.4GHz	802.11b 1Mbps	Back of Panel	25	Off	Full	6	2437	19.36	20.50	1.300	100	1.000	-0.08	0.057	0.074
	Tablet	2	WLAN 2.4GHz	802.11b 1Mbps	Bottom Face	5	Off	Full	6	2437	19.36	20.50	1.300	100	1.000	0.06	0.303	0.394
	Tablet	2	WLAN 2.4GHz	802.11n-HT40 MCS0	Bottom Face	0	On	Reduced	6	2437	14.61	15.00	1.094	89.73	1.114	-0.04	0.393	0.479
02	Tablet	2	WLAN 2.4GHz	802.11b 1Mbps	Edge 3	9	Off	Full	6	2437	19.36	20.50	1.300	100	1.000	-0.09	0.496	**0.645**
	Tablet	2	WLAN 2.4GHz	802.11n-HT40 MCS0	Edge 3	0	On	Reduced	6	2437	14.61	15.00	1.094	89.73	1.114	-0.02	0.393	0.479
	Tablet	2	WLAN 2.4GHz	802.11n-HT40 MCS0	Curved of Edge 3	0	On	Reduced	6	2437	14.61	15.00	1.094	89.73	1.114	0.06	0.510	0.622
	Tablet	2	WLAN 2.4GHz	802.11b 1Mbps	Edge 3	9	Off	Full	1	2412	18.74	20.50	1.500	100	1.000	-0.06	0.407	0.610
	Tablet	2	WLAN 2.4GHz	802.11b 1Mbps	Edge 3	9	Off	Full	11	2462	18.72	20.50	1.507	100	1.000	-0.02	0.395	0.595

<WLAN 5GHz SAR>

Plot No.	EUT Type	Ant. Port	Band	Mode	Test Position	Gap (mm)	Sensor	Power Reduction	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Duty Cycle %	Duty Cycle Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
	Notebook	1	WLAN 5.3GHz	802.11a 6Mbps	Bottom	7	Off	Full	60	5300	14.34	15.00	1.164	94.54	1.058	-0.02	0.632	0.778
	Notebook	1	WLAN 5.3GHz	802.11ac-VHT80 MCS0	Bottom	0	On	Reduced	58	5290	8.75	9.00	1.059	95.07	1.052	0.05	0.724	0.807
	Notebook	1	WLAN 5.3GHz	802.11a 6Mbps	Back of Panel	25	Off	Full	60	5300	14.34	15.00	1.164	94.54	1.058	0.07	0.094	0.116
	Tablet	1	WLAN 5.3GHz	802.11a 6Mbps	Bottom Face	5	Off	Full	60	5300	14.34	15.00	1.164	94.54	1.058	0.03	0.510	0.628
	Tablet	1	WLAN 5.3GHz	802.11ac-VHT80 MCS0	Bottom Face	0	On	Reduced	58	5290	6.19	6.50	1.074	95.07	1.052	0.12	0.232	0.262
	Tablet	1	WLAN 5.3GHz	802.11a 6Mbps	Edge 3	9	Off	Full	60	5300	14.34	15.00	1.164	94.54	1.058	-0.02	0.616	0.759
03	Tablet	1	WLAN 5.3GHz	802.11ac-VHT80 MCS0	Edge 3	0	On	Reduced	58	5290	6.19	6.50	1.074	95.07	1.052	0.03	1.040	**1.175**
	Tablet	1	WLAN 5.3GHz	802.11ac-VHT80 MCS0	Curved of Edge 3	0	On	Reduced	58	5290	6.19	6.50	1.074	95.07	1.052	0.07	0.707	0.799
	Notebook	2	WLAN 5.3GHz	802.11a 6Mbps	Bottom	7	Off	Full	52	5260	14.58	15.00	1.102	94.74	1.056	-0.03	0.527	0.613
	Notebook	2	WLAN 5.3GHz	802.11ac-VHT80 MCS0	Bottom	0	On	Reduced	58	5290	8.26	9.00	1.186	95.07	1.052	0.05	0.499	0.622
	Notebook	2	WLAN 5.3GHz	802.11a 6Mbps	Back of Panel	25	Off	Full	52	5260	14.58	15.00	1.102	94.74	1.056	0.07	0.082	0.096
	Tablet	2	WLAN 5.3GHz	802.11a 6Mbps	Bottom Face	5	Off	Full	52	5260	14.58	15.00	1.102	94.74	1.056	0.01	0.497	0.578
	Tablet	2	WLAN 5.3GHz	802.11ac-VHT80 MCS0	Bottom Face	0	On	Reduced	58	5290	6.04	6.50	1.112	95.07	1.052	-0.09	0.214	0.250
	Tablet	2	WLAN 5.3GHz	802.11a 6Mbps	Edge 3	9	Off	Full	52	5260	14.58	15.00	1.102	94.74	1.056	-0.06	0.602	0.700
04	Tablet	2	WLAN 5.3GHz	802.11ac-VHT80 MCS0	Edge 3	0	On	Reduced	58	5290	6.04	6.50	1.112	95.07	1.052	0.01	0.937	**1.096**
	Tablet	2	WLAN 5.3GHz	802.11ac-VHT80 MCS0	Curved of Edge 3	0	On	Reduced	58	5290	6.04	6.50	1.112	95.07	1.052	0.11	0.884	1.034

Plot No.	EUT Type	Ant. Port	Band	Mode	Test Position	Gap (mm)	Sensor	Power Reduction	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Duty Cycle %	Duty Cycle Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
	Notebook	1	WLAN 5.5GHz	802.11a 6Mbps	Bottom	7	Off	Full	132	5660	14.67	15.00	1.079	94.54	1.058	-0.04	0.612	0.699
	Notebook	1	WLAN 5.5GHz	802.11ac-VHT80 MCS0	Bottom	0	On	Reduced	106	5530	8.85	9.00	1.035	95.07	1.052	0.03	0.504	0.549
	Notebook	1	WLAN 5.5GHz	802.11a 6Mbps	Back of Panel	25	Off	Full	132	5660	14.67	15.00	1.079	94.54	1.058	0.09	0.128	0.146
	Tablet	1	WLAN 5.5GHz	802.11a 6Mbps	Bottom Face	5	Off	Full	132	5660	14.67	15.00	1.079	94.54	1.058	0.12	0.573	0.654
	Tablet	1	WLAN 5.5GHz	802.11ac-VHT80 MCS0	Bottom Face	0	On	Reduced	106	5530	5.41	6.00	1.146	95.07	1.052	0.08	0.130	0.157
	Tablet	1	WLAN 5.5GHz	802.11a 6Mbps	Edge 3	9	Off	Full	132	5660	14.67	15.00	1.079	94.54	1.058	-0.01	0.700	0.799
	Tablet	1	WLAN 5.5GHz	802.11ac-VHT80 MCS0	Edge 3	0	On	Reduced	106	5530	5.41	6.00	1.146	95.07	1.052	0.17	0.662	0.798
	Tablet	1	WLAN 5.5GHz	802.11ac-VHT80 MCS0	Curved of Edge 3	0	On	Reduced	106	5530	5.41	6.00	1.146	95.07	1.052	0.05	0.725	0.874
05	Tablet	1	WLAN 5.5GHz	802.11ac-VHT80 MCS0	Curved of Edge 3	0	On	Reduced	122	5610	5.37	6.00	1.156	95.07	1.052	-0.09	0.966	**1.175**
	Tablet	1	WLAN 5.5GHz	802.11ac-VHT80 MCS0	Curved of Edge 3	0	On	Reduced Level 2	138	5690	5.23	6.00	1.194	95.07	1.052	-0.09	0.668	0.839
	Notebook	2	WLAN 5.5GHz	802.11a 6Mbps	Bottom	7	Off	Full	108	5540	14.88	15.00	1.028	94.74	1.056	-0.03	0.641	0.696
	Notebook	2	WLAN 5.5GHz	802.11ac-VHT80 MCS0	Bottom	0	On	Reduced	106	5530	8.91	9.00	1.021	95.07	1.052	0.09	0.716	0.769
	Notebook	2	WLAN 5.5GHz	802.11a 6Mbps	Back of Panel	25	Off	Full	108	5540	14.88	15.00	1.028	94.74	1.056	0.16	0.095	0.104
	Tablet	2	WLAN 5.5GHz	802.11a 6Mbps	Bottom Face	5	Off	Full	108	5540	14.88	15.00	1.028	94.74	1.056	0.02	0.475	0.516
	Tablet	2	WLAN 5.5GHz	802.11ac-VHT80 MCS0	Bottom Face	0	On	Reduced	106	5530	5.70	6.00	1.072	95.07	1.052	0.09	0.173	0.195
	Tablet	2	WLAN 5.5GHz	802.11a 6Mbps	Edge 3	9	Off	Full	108	5540	14.88	15.00	1.028	94.74	1.056	0.01	0.765	0.830
	Tablet	2	WLAN 5.5GHz	802.11a 6Mbps	Edge 3	9	Off	Full	136	5680	14.44	15.00	1.138	94.74	1.056	0.06	0.744	0.894
	Tablet	2	WLAN 5.5GHz	802.11ac-VHT80 MCS0	Edge 3	0	On	Reduced	106	5530	5.70	6.00	1.072	95.07	1.052	-0.11	1.040	1.172
	Tablet	2	WLAN 5.5GHz	802.11ac-VHT80 MCS0	Edge 3	0	On	Reduced	122	5610	5.51	6.00	1.119	95.07	1.052	0.09	0.932	1.098
06	Tablet	2	WLAN 5.5GHz	802.11ac-VHT80 MCS0	Curved of Edge 3	0	On	Reduced	106	5530	5.70	6.00	1.072	95.07	1.052	0.09	1.060	**1.195**
	Tablet	2	WLAN 5.5GHz	802.11ac-VHT80 MCS0	Curved of Edge 3	0	On	Reduced	122	5610	5.51	6.00	1.119	95.07	1.052	-0.05	0.979	1.153
	Tablet	2	WLAN 5.5GHz	802.11ac-VHT80 MCS0	Curved of Edge 3	0	On	Reduced Level 2	138	5690	5.45	6.00	1.135	95.07	1.052	-0.01	0.923	1.102

Plot No.	EUT Type	Ant. Port	Band	Mode	Test Position	Gap (mm)	Sensor	Power Reduction	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Duty Cycle %	Duty Cycle Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
	Notebook	1	WLAN 5.8GHz	802.11a 6Mbps	Bottom	7	Off	Full	165	5825	14.43	15.00	1.140	94.54	1.058	-0.08	0.303	0.366
	Notebook	1	WLAN 5.8GHz	802.11n-HT40 MCS0	Bottom	0	On	Reduced	159	5795	8.81	9.00	1.045	89.73	1.114	0.03	0.608	0.708
	Notebook	1	WLAN 5.8GHz	802.11a 6Mbps	Back of Panel	25	Off	Full	165	5825	14.43	15.00	1.140	94.54	1.058	-0.11	0.117	0.141
	Tablet	1	WLAN 5.8GHz	802.11a 6Mbps	Bottom Face	5	Off	Full	165	5825	14.43	15.00	1.140	94.54	1.058	-0.19	0.261	0.315
	Tablet	1	WLAN 5.8GHz	802.11ac-VHT80 MCS0	Bottom Face	0	On	Reduced	155	5775	5.04	5.50	1.112	95.07	1.052	0.05	0.075	0.088
	Tablet	1	WLAN 5.8GHz	802.11a 6Mbps	Edge 3	9	Off	Full	165	5825	14.43	15.00	1.140	94.54	1.058	0.02	0.345	0.416
	Tablet	1	WLAN 5.8GHz	802.11ac-VHT80 MCS0	Edge 3	0	On	Reduced	155	5775	5.04	5.50	1.112	95.07	1.052	0.09	0.668	0.781
07	Tablet	1	WLAN 5.8GHz	802.11ac-VHT80 MCS0	Curved of Edge 3	0	On	Reduced	155	5775	5.04	5.50	1.112	95.07	1.052	-0.01	0.701	**0.820**
	Notebook	2	WLAN 5.8GHz	802.11a 6Mbps	Bottom	7	Off	Full	165	5825	14.44	15.00	1.138	94.74	1.056	-0.11	0.607	0.729
	Notebook	2	WLAN 5.8GHz	802.11n-HT40 MCS0	Bottom	0	On	Reduced	159	5795	8.90	9.00	1.023	89.47	1.118	0.01	0.646	0.739
	Notebook	2	WLAN 5.8GHz	802.11a 6Mbps	Back of Panel	25	Off	Full	165	5825	14.44	15.00	1.138	94.74	1.056	0.05	0.125	0.150
	Tablet	2	WLAN 5.8GHz	802.11a 6Mbps	Bottom Face	5	Off	Full	165	5825	14.44	15.00	1.138	94.74	1.056	-0.09	0.346	0.416
	Tablet	2	WLAN 5.8GHz	802.11ac-VHT80 MCS0	Bottom Face	0	On	Reduced	155	5775	5.08	5.50	1.102	95.07	1.052	-0.09	0.153	0.177
	Tablet	2	WLAN 5.8GHz	802.11a 6Mbps	Edge 3	9	Off	Full	165	5825	14.44	15.00	1.138	94.74	1.056	-0.19	0.718	0.863
	Tablet	2	WLAN 5.8GHz	802.11a 6Mbps	Edge 3	9	Off	Full	157	5785	14.36	15.00	1.159	94.74	1.056	-0.08	0.920	1.126
	Tablet	2	WLAN 5.8GHz	802.11ac-VHT80 MCS0	Edge 3	0	On	Reduced	155	5775	5.08	5.50	1.102	95.07	1.052	0.04	0.987	1.144
08	Tablet	2	WLAN 5.8GHz	802.11ac-VHT80 MCS0	Curved of Edge 3	0	On	Reduced	155	5775	5.08	5.50	1.102	95.07	1.052	-0.09	1.020	**1.182**

<Bluetooth SAR>

Plot No.	EUT Type	Ant. Port	Band	Mode	Test Position	Gap (mm)	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Duty Cycle %	Duty Cycle Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
	Notebook	1	Bluetooth	1Mbps	Bottom	0	78	2480	7.39	8.50	1.291	76.94	1.083	0.01	0.001	0.001
	Notebook	1	Bluetooth	1Mbps	Back of Panel	25	78	2480	7.39	8.50	1.291	76.94	1.083	0.1	0.001	0.001
	Tablet	1	Bluetooth	1Mbps	Bottom Face	0	78	2480	7.39	8.50	1.291	76.94	1.083	0.05	0.001	0.001
	Tablet	1	Bluetooth	1Mbps	Edge 3	0	78	2480	7.39	8.50	1.291	76.94	1.083	-0.09	0.002	0.003
09	Tablet	1	Bluetooth	1Mbps	Curved of Edge 3	0	78	2480	7.39	8.50	1.291	76.94	1.083	0.08	0.00361	**0.005**
	Tablet	1	Bluetooth	1Mbps	Curved of Edge 3	0	0	2402	6.62	8.50	1.542	76.94	1.083	0.07	0.003	0.005
	Tablet	1	Bluetooth	1Mbps	Curved of Edge 3	0	39	2441	6.95	8.50	1.429	76.94	1.083	0.06	0.002	0.003

15.2 Repeated SAR Measurement

No.	EUT Type	Ant. Port	Band	Mode	Test Position	Gap (mm)	Sensor	Power Reduction	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Duty Cycle %	Duty Cycle Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Ratio	Reported 1g SAR (W/kg)
1st	Tablet	1	WLAN 5.3GHz	802.11ac-VHT80 MCS0	Edge 3	0	On	Reduced	58	5290	6.19	6.50	1.074	95.07	1.052	0.03	1.040	1	1.175
2nd	Tablet	1	WLAN 5.3GHz	802.11ac-VHT80 MCS0	Edge 3	0	On	Reduced	58	5290	6.19	6.50	1.074	95.07	1.052	0.17	1.010	1.030	1.141
1st	Tablet	2	WLAN 5.5GHz	802.11ac-VHT80 MCS0	Curved of Edge 3	0	On	Reduced	106	5530	5.70	6.00	1.072	95.07	1.052	0.09	1.060	1	1.195
2nd	Tablet	2	WLAN 5.5GHz	802.11ac-VHT80 MCS0	Curved of Edge 3	0	On	Reduced	106	5530	5.70	6.00	1.072	95.07	1.052	0.11	1.030	1.029	1.161
1st	Tablet	2	WLAN 5.8GHz	802.11ac-VHT80 MCS0	Curved of Edge 3	0	On	Reduced	155	5775	5.08	5.50	1.102	95.07	1.052	-0.09	1.020	1	1.182
2nd	Tablet	2	WLAN 5.8GHz	802.11ac-VHT80 MCS0	Curved of Edge 3	0	On	Reduced	155	5775	5.08	5.50	1.102	95.07	1.052	0.04	0.998	1.022	1.157

General Note:

1. Per KDB 865664 D01v01r04, for each frequency band, repeated SAR measurement is required only when the measured SAR is ≥0.8W/kg.
2. Per KDB 865664 D01v01r04, if the ratio among the repeated measurement is ≤ 1.2 and the measured SAR <1.45W/kg, only one repeated measurement is required.
3. The ratio is the difference in percentage between original and repeated *measured SAR*.
4. All measurement SAR result is scaled-up to account for tune-up tolerance and is compliant.

16. Simultaneous Transmission Analysis

NO.	Simultaneous Transmission Configurations	Supported
1.	WLAN 2.4GHz Antenna 1 + WLAN 2.4GHz Antenna 2	Yes
2.	WLAN 5GHz Antenna 1 + WLAN 5GHz Antenna 2	Yes
3.	WLAN 2.4GHz Antenna 2 + Bluetooth	Yes
4.	WLAN 5GHz Antenna 2 + Bluetooth	Yes

General Note:

1. Bluetooth and WLAN share the same antenna 1, and cannot transmit simultaneously.
2. WLAN 2.4GHz MIMO SAR and WLAN 5GHz MIMO SAR evaluated separately and complied, so no need add SAR test results of each antenna in SISO mode for co-located analysis.
3. For SAR testing was performed on single antenna RF power in SISO mode is larger or equal to the single antenna RF power in MIMO mode, and for RF exposure assessment of MIMO mode simultaneous transmission exclusion analysis was performed with SAR test results of each antenna in SISO mode.
4. For distance SAR, Bluetooth tested at 0mm separation is worse and the test data is used for conservative SAR summation.
5. The reported SAR summation is calculated based on the same configuration and test position.
6. Per KDB 447498 D01v06, simultaneous transmission SAR is compliant if,
   i) Scalar SAR summation < 1.6W/kg.
   ii) SPLSR = (SAR1 + SAR2)^1.5 / (min. separation distance, mm), and the peak separation distance is determined from the square root of [(x1-x2)2 + (y1-y2)2 + (z1-z2)2], where (x1, y1, z1) and (x2, y2, z2) are the coordinates of the extrapolated peak SAR locations in the zoom scan.
   iii) If SPLSR ≤ 0.04, simultaneously transmission SAR measurement is not necessary.
   iv) Simultaneously transmission SAR measurement, and the reported multi-band SAR < 1.6W/kg.
   v) The SPLSR calculated results please refer to section 16.2.

16.1 Body Exposure Conditions

<WLAN Ant.1 + WLAN Ant.2>

Exposure Position	1	2	3	4	1+2 Summed 1g SAR (W/kg)	3+4		
	2.4GHz WLAN Ant.1	2.4GHz WLAN Ant.2	5GHz WLAN Ant.1	5GHz WLAN Ant.2		Summed 1g SAR (W/kg)	SPLSR	Case No.
	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)				
Bottom at 7mm	0.390	0.568	0.778	0.729	0.96	1.51		
Bottom at 0mm	0.217	0.352	0.807	0.769	0.57	**1.58**		
Back of Panel at 25mm	0.078	0.074	0.146	0.150	0.15	0.30		
Bottom Face at 5mm	0.291	0.394	0.654	0.578	0.69	1.23		
Bottom Face at 0mm	0.230	0.479	0.262	0.250	0.71	0.51		
Edge 3 at 9mm	0.308	0.645	0.799	1.126	0.95	**1.93**	**0.02**	**#1**
Edge 3 at 0mm	0.490	0.610	1.175	1.172	1.10	**2.35**	**0.03**	**#2**
Curved of Edge 3 at 0mm	0.875	0.622	1.175	1.195	**1.50**	**2.37**	**0.03**	**#3**

<WLAN + Bluetooth>

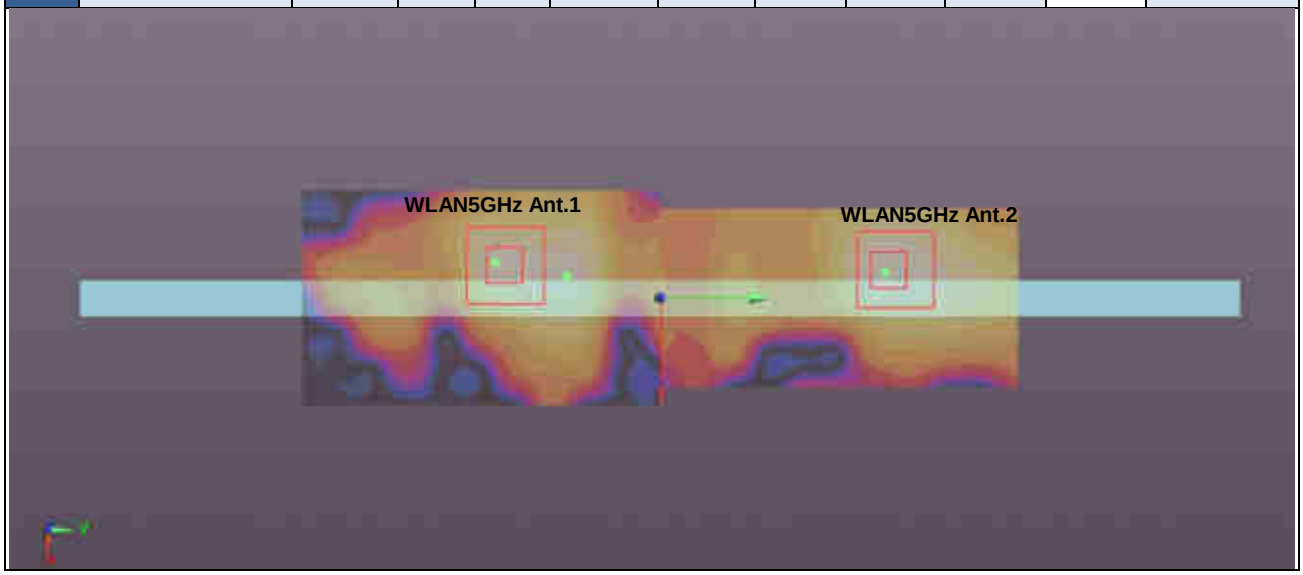
Exposure Position	2	4	5	2+5 Summed 1g SAR (W/kg)	4+5 Summed 1g SAR (W/kg)
	2.4GHz WLAN Ant.2	5GHz WLAN Ant.2	Bluetooth Ant.1		
	1g SAR (W/kg)	1g SAR (W/kg)	Estimated 1g SAR (W/kg)		
Bottom at 7mm	0.568	0.729	0.001	0.57	0.73
Bottom at 0mm	0.352	0.769	0.001	0.35	0.77
Back of Panel at 25mm	0.074	0.150	0.001	0.08	0.15
Bottom Face at 5mm	0.394	0.578	0.001	0.40	0.58
Bottom Face at 0mm	0.479	0.250	0.001	0.48	0.25
Edge 3 at 9mm	0.645	1.126	0.003	**0.65**	1.13
Edge 3 at 0mm	0.610	1.172	0.003	0.61	1.18
Curved of Edge 3 at 0mm	0.622	1.195	0.005	0.63	**1.20**

16.2 SPLSR Evaluation and Analysis

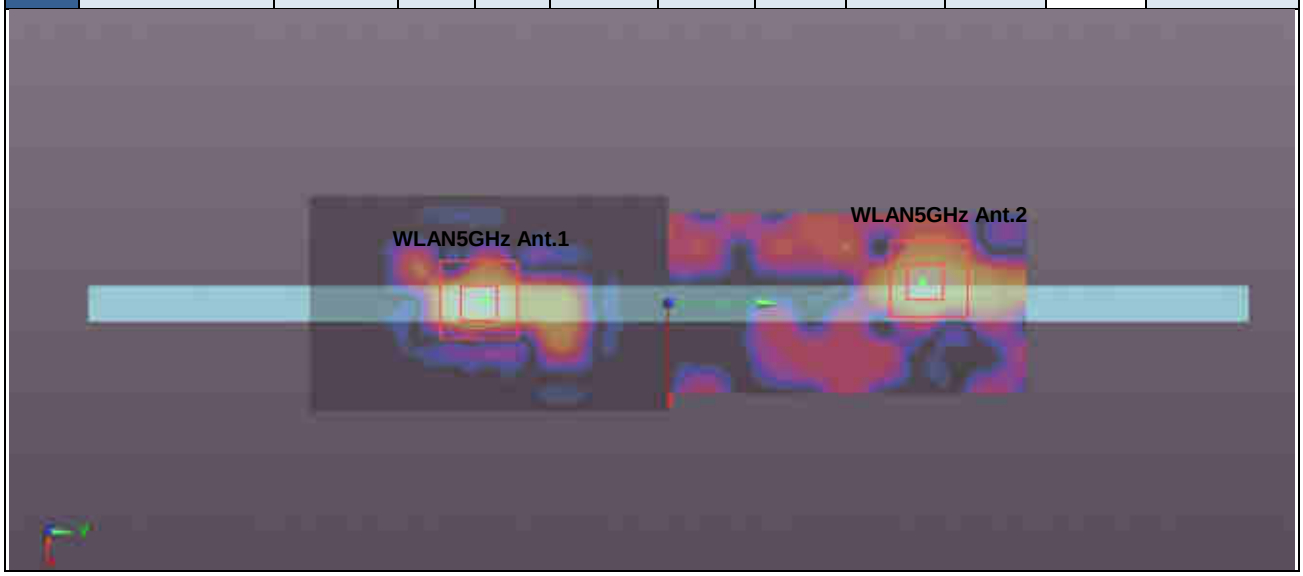
General Note:

1. When standalone SAR is measured for both antennas in the pair, the peak location separation distance is computed by the square root of [(x1−x2)2 + (y1−y2)2 + (z1−z2)2], where (x1, y1, z1) and (x2, y2, z2) are the coordinates in the area scans or extrapolated peak SAR locations in the zoom scans, as appropriate.
2. SPLSR = $(SAR_1 + SAR_2)^{1.5}$ / (*min. separation distance, mm*). If SPLSR ≤ 0.04, simultaneously transmission SAR measurement is not necessary.

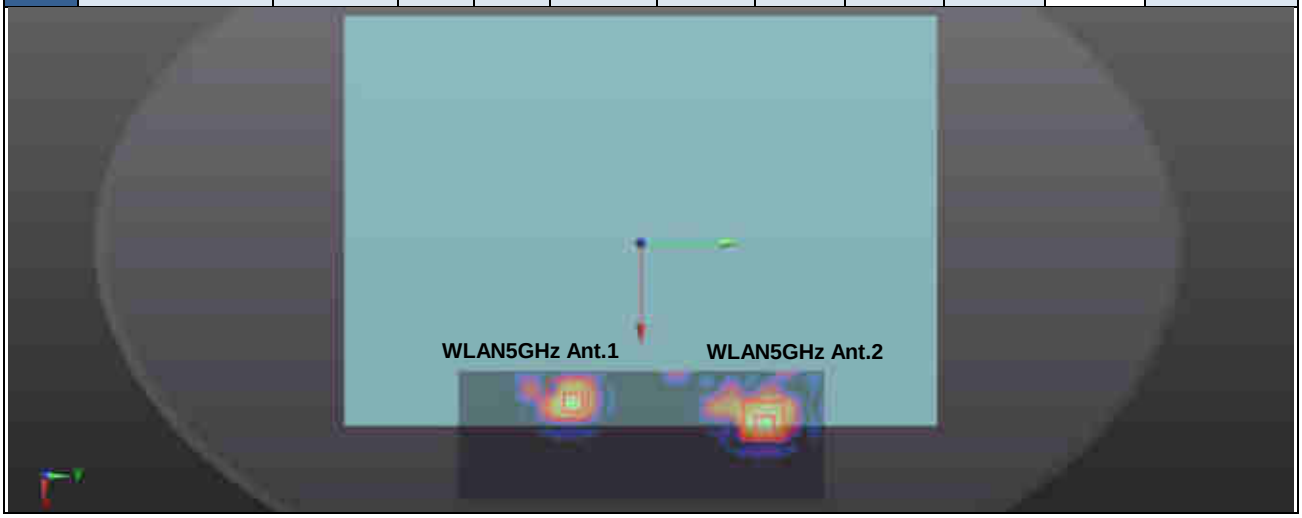
Case #1	Band	Position	SAR (W/kg)	Gap (mm)	SAR peak location (m) X	Y	Z	3D distance (mm)	Summed SAR (W/kg)	SPLSR Results	Simultaneous SAR
	WLAN5GHz Ant.1	Edge 3	0.799	9	-0.008	-0.044	-0.179	109.0	1.93	0.02	Not required
	WLAN5GHz Ant.2		1.126	9	-0.009	0.065	-0.179				



Case #2	Band	Position	SAR (W/kg)	Gap (mm)	SAR peak location (m) X	SAR peak location (m) Y	SAR peak location (m) Z	3D distance (mm)	Summed SAR (W/kg)	SPLSR Results	Simultaneous SAR
	WLAN5GHz Ant.1	Edge 3	1.175	0	0.001	-0.053	-0.178	126.1	2.35	0.03	Not required
	WLAN5GHz Ant.2		1.172	0	-0.004	0.073	-0.179				



Case #3	Band	Position	SAR (W/kg)	Gap (mm)	SAR peak location (m) X	SAR peak location (m) Y	SAR peak location (m) Z	3D distance (mm)	Summed SAR (W/kg)	SPLSR Results	Simultaneous SAR
	WLAN5GHz Ant.1	Curved of Edge 3	1.175	0	0.116	-0.058	-0.177	125.0	2.37	0.03	Not required
	WLAN5GHz Ant.2		1.195	0	0.1	0.066	-0.177				



Test Engineer: Nick Hu

17. Uncertainty Assessment

The component of uncertainly may generally be categorized according to the methods used to evaluate them. The evaluation of uncertainly by the statistical analysis of a series of observations is termed a Type An evaluation of uncertainty. The evaluation of uncertainty by means other than the statistical analysis of a series of observation is termed a Type B evaluation of uncertainty. Each component of uncertainty, however evaluated, is represented by an estimated standard deviation, termed standard uncertainty, which is determined by the positive square root of the estimated variance.

A Type A evaluation of standard uncertainty may be based on any valid statistical method for treating data. This includes calculating the standard deviation of the mean of a series of independent observations; using the method of least squares to fit a curve to the data in order to estimate the parameter of the curve and their standard deviations; or carrying out an analysis of variance in order to identify and quantify random effects in certain kinds of measurement.

A type B evaluation of standard uncertainty is typically based on scientific judgment using all of the relevant information available. These may include previous measurement data, experience, and knowledge of the behavior and properties of relevant materials and instruments, manufacture's specification, data provided in calibration reports and uncertainties assigned to reference data taken from handbooks. Broadly speaking, the uncertainty is either obtained from an outdoor source or obtained from an assumed distribution, such as the normal distribution, rectangular or triangular distributions indicated in table below.

Uncertainty Distributions	Normal	Rectangular	Triangular	U-Shape
Multi-plying Factor[a]	1/k[b]	$1/\sqrt{3}$	$1/\sqrt{6}$	$1/\sqrt{2}$

(a) standard uncertainty is determined as the product of the multiplying factor and the estimated range of variations in the measured quantity

(b) κ is the coverage factor

Table 17.1. Standard Uncertainty for Assumed Distribution

The combined standard uncertainty of the measurement result represents the estimated standard deviation of the result. It is obtained by combining the individual standard uncertainties of both Type A and Type B evaluation using the usual "root-sum-squares" (RSS) methods of combining standard deviations by taking the positive square root of the estimated variances.

Expanded uncertainty is a measure of uncertainty that defines an interval about the measurement result within which the measured value is confidently believed to lie. It is obtained by multiplying the combined standard uncertainty by a coverage factor. Typically, the coverage factor ranges from 2 to 3. Using a coverage factor allows the true value of a measured quantity to be specified with a defined probability within the specified uncertainty range. For purpose of this document, a coverage factor two is used, which corresponds to confidence interval of about 95 %. The DASY uncertainty Budget is shown in the following tables.

Error Description	Uncertainty Value (±%)	Probability	Divisor	(Ci) 1g	(Ci) 10g	Standard Uncertainty (1g) (±%)	Standard Uncertainty (10g) (±%)
Measurement System							
Probe Calibration	6.0	N	1	1	1	6.0	6.0
Axial Isotropy	4.7	R	1.732	0.7	0.7	1.9	1.9
Hemispherical Isotropy	9.6	R	1.732	0.7	0.7	3.9	3.9
Boundary Effects	1.0	R	1.732	1	1	0.6	0.6
Linearity	4.7	R	1.732	1	1	2.7	2.7
System Detection Limits	1.0	R	1.732	1	1	0.6	0.6
Modulation Response	3.2	R	1.732	1	1	1.8	1.8
Readout Electronics	0.3	N	1	1	1	0.3	0.3
Response Time	0.0	R	1.732	1	1	0.0	0.0
Integration Time	2.6	R	1.732	1	1	1.5	1.5
RF Ambient Noise	3.0	R	1.732	1	1	1.7	1.7
RF Ambient Reflections	3.0	R	1.732	1	1	1.7	1.7
Probe Positioner	0.4	R	1.732	1	1	0.2	0.2
Probe Positioning	2.9	R	1.732	1	1	1.7	1.7
Max. SAR Eval.	2.0	R	1.732	1	1	1.2	1.2
Test Sample Related							
Device Positioning	3.0	N	1	1	1	3.0	3.0
Device Holder	3.6	N	1	1	1	3.6	3.6
Power Drift	5.0	R	1.732	1	1	2.9	2.9
Power Scaling	0.0	R	1.732	1	1	0.0	0.0
Phantom and Setup							
Phantom Uncertainty	6.1	R	1.732	1	1	3.5	3.5
SAR correction	0.0	R	1.732	1	0.84	0.0	0.0
Liquid Conductivity Repeatability	0.2	N	1	0.78	0.71	0.1	0.1
Liquid Conductivity (target)	5.0	R	1.732	0.78	0.71	2.3	2.0
Liquid Conductivity (mea.)	2.5	R	1.732	0.78	0.71	1.1	1.0
Temp. unc. - Conductivity	3.4	R	1.732	0.78	0.71	1.5	1.4
Liquid Permittivity Repeatability	0.15	N	1	0.23	0.26	0.0	0.0
Liquid Permittivity (target)	5.0	R	1.732	0.23	0.26	0.7	0.8
Liquid Permittivity (mea.)	2.5	R	1.732	0.23	0.26	0.3	0.4
Temp. unc. - Permittivity	0.83	R	1.732	0.23	0.26	0.1	0.1
Combined Std. Uncertainty						11.4%	11.4%
Coverage Factor for 95 %						K=2	K=2
Expanded STD Uncertainty						22.9%	22.7%

Table 17.2. Uncertainty Budget for frequency range 300 MHz to 3 GHz

Error Description	Uncertainty Value (±%)	Probability	Divisor	(Ci) 1g	(Ci) 10g	Standard Uncertainty (1g) (±%)	Standard Uncertainty (10g) (±%)
Measurement System							
Probe Calibration	6.55	N	1	1	1	6.6	6.6
Axial Isotropy	4.7	R	1.732	0.7	0.7	1.9	1.9
Hemispherical Isotropy	9.6	R	1.732	0.7	0.7	3.9	3.9
Boundary Effects	2.0	R	1.732	1	1	1.2	1.2
Linearity	4.7	R	1.732	1	1	2.7	2.7
System Detection Limits	1.0	R	1.732	1	1	0.6	0.6
Modulation Response	3.2	R	1.732	1	1	1.8	1.8
Readout Electronics	0.3	N	1	1	1	0.3	0.3
Response Time	0.0	R	1.732	1	1	0.0	0.0
Integration Time	2.6	R	1.732	1	1	1.5	1.5
RF Ambient Noise	3.0	R	1.732	1	1	1.7	1.7
RF Ambient Reflections	3.0	R	1.732	1	1	1.7	1.7
Probe Positioner	0.4	R	1.732	1	1	0.2	0.2
Probe Positioning	6.7	R	1.732	1	1	3.9	3.9
Max. SAR Eval.	4.0	R	1.732	1	1	2.3	2.3
Test Sample Related							
Device Positioning	3.0	N	1	1	1	3.0	3.0
Device Holder	3.6	N	1	1	1	3.6	3.6
Power Drift	5.0	R	1.732	1	1	2.9	2.9
Power Scaling	0.0	R	1.732	1	1	0.0	0.0
Phantom and Setup							
Phantom Uncertainty	6.6	R	1.732	1	1	3.8	3.8
SAR correction	0.0	R	1.732	1	0.84	0.0	0.0
Liquid Conductivity Repeatability	0.2	N	1	0.78	0.71	0.1	0.1
Liquid Conductivity (target)	5.0	R	1.732	0.78	0.71	2.3	2.0
Liquid Conductivity (mea.)	2.5	R	1.732	0.78	0.71	1.1	1.0
Temp. unc. - Conductivity	3.4	R	1.732	0.78	0.71	1.5	1.4
Liquid Permittivity Repeatability	0.15	N	1	0.23	0.26	0.0	0.0
Liquid Permittivity (target)	5.0	R	1.732	0.23	0.26	0.7	0.8
Liquid Permittivity (mea.)	2.5	R	1.732	0.23	0.26	0.3	0.4
Temp. unc. - Permittivity	0.83	R	1.732	0.23	0.26	0.1	0.1
Combined Std. Uncertainty						12.5%	12.5%
Coverage Factor for 95 %						K=2	K=2
Expanded STD Uncertainty						25.1%	25.0%

Table 17.3. Uncertainty Budget for frequency range 3 GHz to 6 GHz

18. References

[1] FCC 47 CFR Part 2 “Frequency Allocations and Radio Treaty Matters; General Rules and Regulations”

[2] ANSI/IEEE Std. C95.1-1992, “IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz”, September 1992

[3] IEEE Std. 1528-2013, “IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques”, Sep 2013

[4] SPEAG DASY System Handbook

[5] FCC KDB 865664 D01 v01r04, "SAR Measurement Requirements for 100 MHz to 6 GHz", Aug 2015

[6] FCC KDB 865664 D02 v01r02, “RF Exposure Compliance Reporting and Documentation Considerations” Oct 2015

[7] FCC KDB 447498 D01 v06, “Mobile and Portable Device RF Exposure Procedures and Equipment Authorization Policies”, Oct 2015

[8] FCC KDB 248227 D01 v02r02, “SAR Guidance for IEEE 802.11 (WiFi) Transmitters”, Oct 2015.

[9] FCC KDB 616217 D04 v01r02, “SAR Evaluation Considerations for Laptop, Notebook, Netbook and Tablet Computers”, Oct 2015

Appendix A. Plots of System Performance Check

The plots are shown as follows.

Test Laboratory: Sporton International Inc. SAR/HAC Testing Lab Date: 2017.6.25

System Check_Body_2450MHz

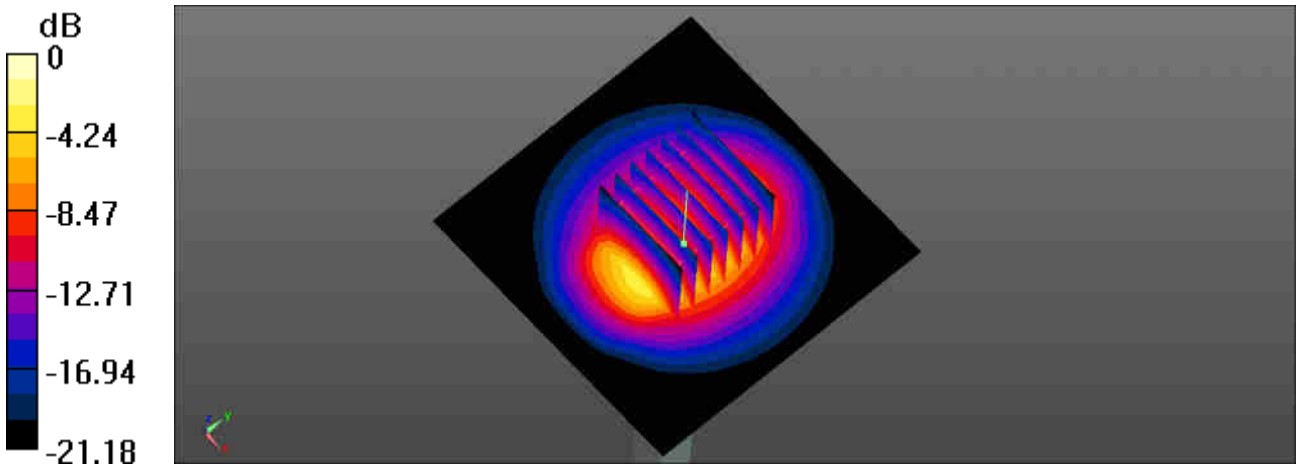
DUT: D2450V2 - SN:840

Communication System: UID 0, CW; Frequency: 2450 MHz;Duty Cycle: 1:1
Medium: MSL_2450 Medium parameters used: f = 2450 MHz; σ = 1.987 S/m; ε_r = 51.883; ρ = 1000 kg/m^3
Ambient Temperature：23.5 ℃; Liquid Temperature：22.5 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3857; ConvF(7.7, 7.7, 7.7); Calibrated: 2017.5.26;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1210; Calibrated: 2017.5.25
- Phantom: SAM4; Type: SAM; Serial: TP-1127
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Pin=250mW/Area Scan (71x71x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 18.8 W/kg

Pin=250mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 83.80 V/m; Power Drift = -0.17 dB
Peak SAR (extrapolated) = 24.2 W/kg
SAR(1 g) = 12.1 W/kg; SAR(10 g) = 5.7 W/kg
Maximum value of SAR (measured) = 18.3 W/kg



0 dB = 18.3 W/kg = 12.62 dBW/kg

Test Laboratory: Sporton International Inc. SAR/HAC Testing Lab Date: 2017.6.26

System Check_Body_5250MHz

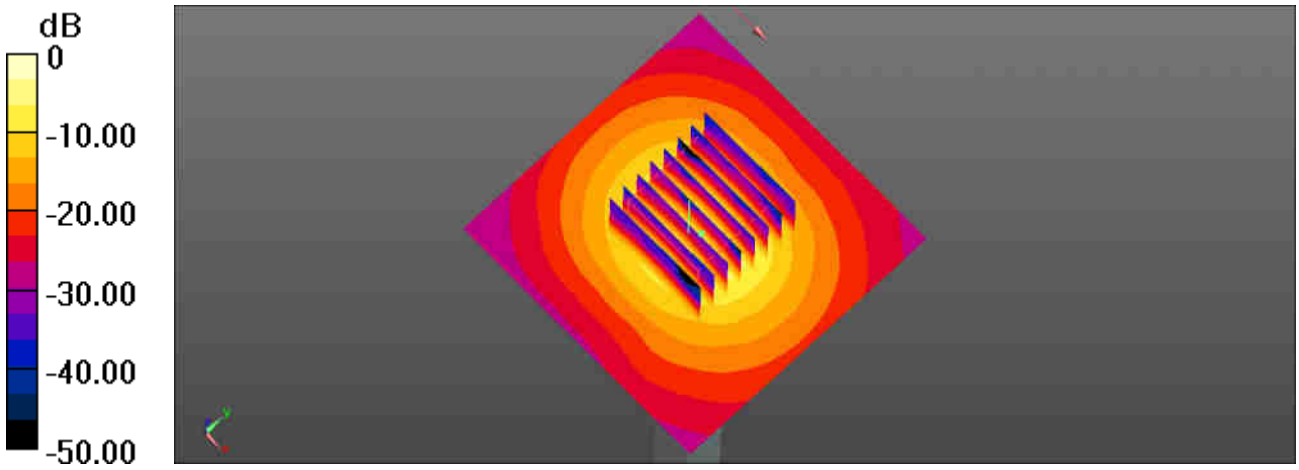
DUT: D5GHzV2-SN:1113

Communication System: UID 0, CW (0); Frequency: 5250 MHz;Duty Cycle: 1:1
Medium: MSL_5000 Medium parameters used: f = 5250 MHz; σ = 5.354 S/m; ε_r = 48.459; ρ = 1000 kg/m^3
Ambient Temperature：23.6 ℃; Liquid Temperature：22.6 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3857; ConvF(4.72, 4.72, 4.72); Calibrated: 2017.5.26;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1210; Calibrated: 2017.5.25
- Phantom: SAM4; Type: SAM; Serial: TP-1127
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

\Pin=100mW/Area Scan (71x71x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 17.8 W/kg

\Pin=100mW/Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 40.90 V/m; Power Drift = -0.10 dB
Peak SAR (extrapolated) = 30.8 W/kg
SAR(1 g) = 7.49 W/kg; SAR(10 g) = 2.11 W/kg
Maximum value of SAR (measured) = 17.9 W/kg



0 dB = 17.9 W/kg = 12.53 dBW/kg

Test Laboratory: Sporton International Inc. SAR/HAC Testing Lab Date: 2017.6.28

System Check_Body_5600MHz

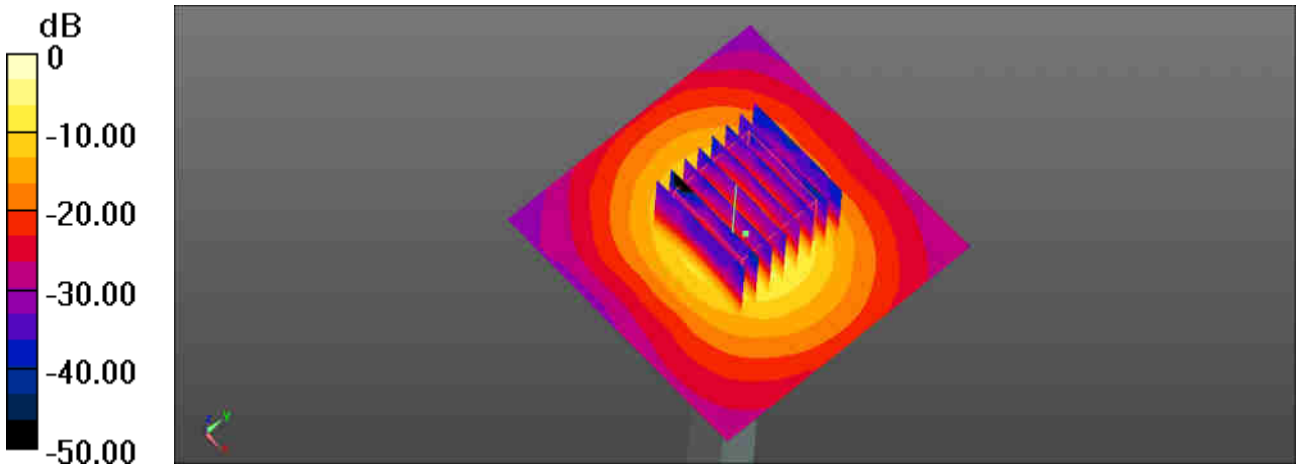
DUT: D5GHzV2-SN:1113

Communication System: UID 0, CW; Frequency: 5600 MHz;Duty Cycle: 1:1
Medium: MSL_5000 Medium parameters used: f = 5600 MHz; σ = 5.849 S/m; ε_r = 47.666; ρ = 1000 kg/m^3
Ambient Temperature：23.4 ℃； Liquid Temperature：22.7 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3857; ConvF(4.01, 4.01, 4.01); Calibrated: 2017.5.26;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1210; Calibrated: 2017.5.25
- Phantom: SAM4; Type: SAM; Serial: TP-1127
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Pin=100mW/Area Scan (71x71x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 19.2 W/kg

Pin=100mW/Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 39.85 V/m; Power Drift = -0.10 dB
Peak SAR (extrapolated) = 33.5 W/kg
SAR(1 g) = 7.78 W/kg; SAR(10 g) = 2.17 W/kg
Maximum value of SAR (measured) = 19.2 W/kg



0 dB = 19.2 W/kg = 12.83 dBW/kg

Test Laboratory: Sporton International Inc. SAR/HAC Testing Lab Date: 2017.6.30

System Check_Body_5750MHz

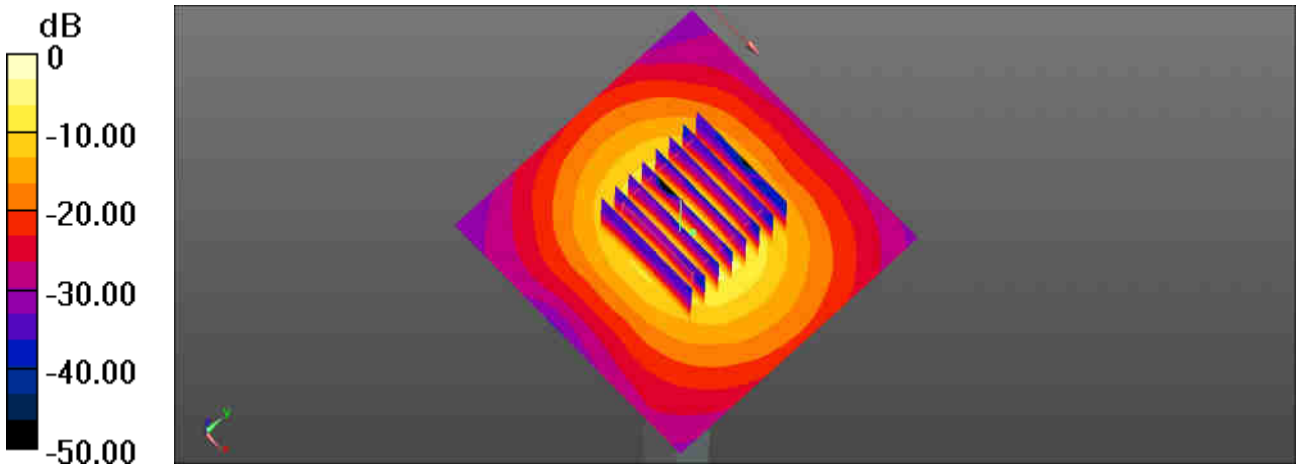
DUT: D5GHzV2-SN:1113

Communication System: UID 0, CW (0); Frequency: 5750 MHz;Duty Cycle: 1:1
Medium: MSL_5000 Medium parameters used: f = 5750 MHz; σ = 6.058 S/m; ε_r = 47.348; ρ = 1000 kg/m^3
Ambient Temperature：23.5 ℃; Liquid Temperature：22.8 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3857; ConvF(4.31, 4.31, 4.31); Calibrated: 2017.5.26;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1210; Calibrated: 2017.5.25
- Phantom: SAM4; Type: SAM; Serial: TP-1127
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Pin=100mW/Area Scan (71x71x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 18.2 W/kg

Pin=100mW/Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 37.39 V/m; Power Drift = -0.14 dB
Peak SAR (extrapolated) = 33.2 W/kg
SAR(1 g) = 7.33 W/kg; SAR(10 g) = 2.05 W/kg
Maximum value of SAR (measured) = 18.0 W/kg



0 dB = 18.0 W/kg = 12.55 dBW/kg

Appendix B. Plots of High SAR Measurement

The plots are shown as follows.

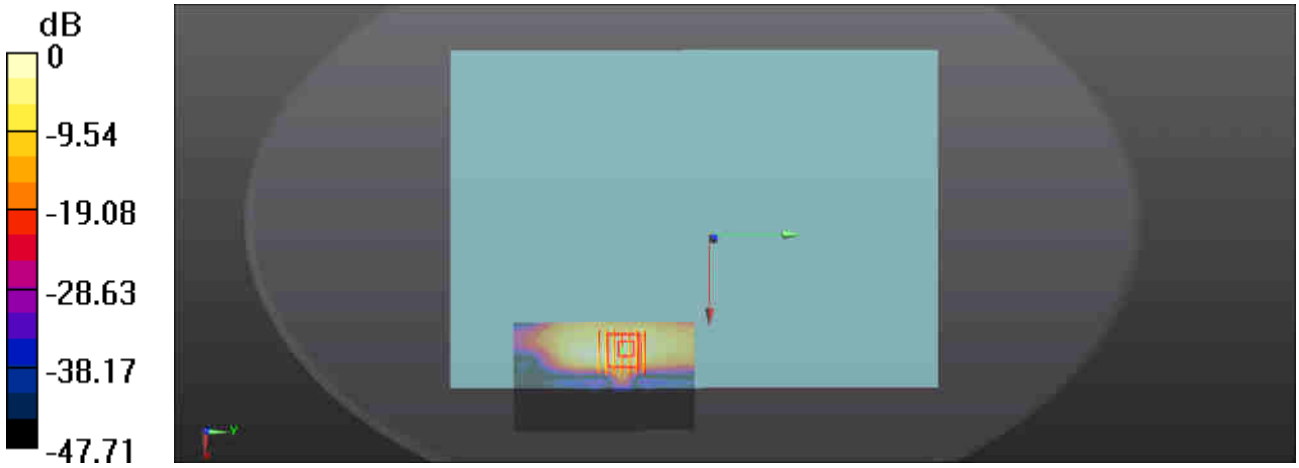
01_WLAN2.4GHz_802.11b 1Mbps_Curved of Edge 3_0mm_Ant.1_Ch9_Sensor On

Communication System: UID 0, WIFI (0); Frequency: 2452 MHz;Duty Cycle: 1:1.114
Medium: MSL_2450 Medium parameters used: f = 2452 MHz; σ = 1.99 S/m; ε_r = 51.875; ρ = 1000 kg/m^3
Ambient Temperature：23.5 ℃; Liquid Temperature：22.5 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3857; ConvF(7.7, 7.7, 7.7); Calibrated: 2017.5.26;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1210; Calibrated: 2017.5.25
- Phantom: SAM4; Type: SAM; Serial: TP-1127
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch9/Area Scan (61x101x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 1.09 W/kg

Ch9/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 0 V/m; Power Drift = -0.06 dB
Peak SAR (extrapolated) = 1.39 W/kg
SAR(1 g) = 0.497 W/kg; SAR(10 g) = 0.199 W/kg
Maximum value of SAR (measured) = 0.950 W/kg



0 dB = 0.950 W/kg = -0.22 dBW/kg

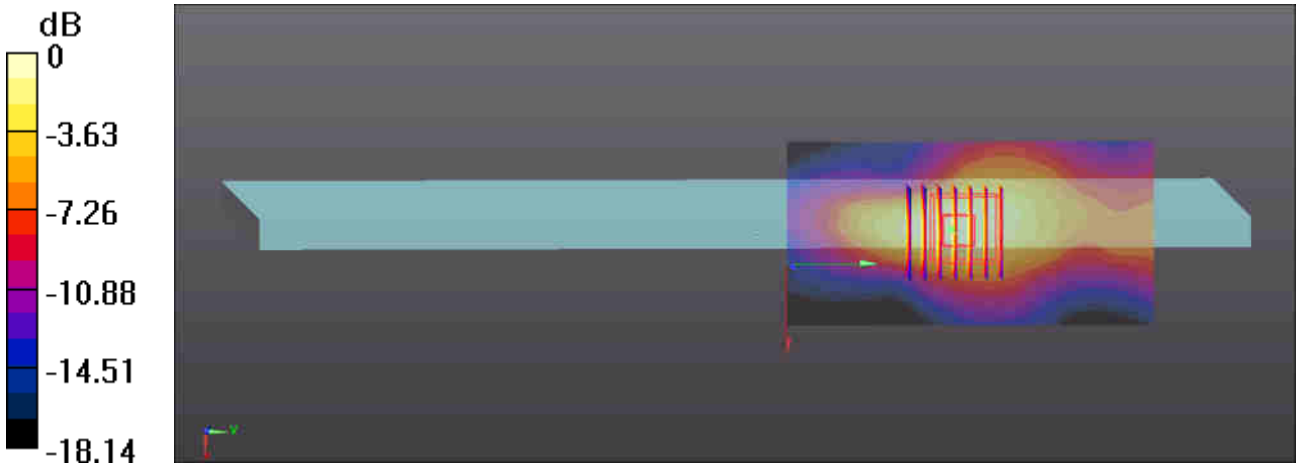
02_WLAN2.4GHz_802.11b 1Mbps_Edge 3_9mm_Ch6_Ant.2_Sensor Off

Communication System: UID 0, WIFI (0); Frequency: 2437 MHz;Duty Cycle: 1:1
Medium: MSL_2450 Medium parameters used: f = 2437 MHz; σ = 1.97 S/m; ε_r = 51.937; ρ = 1000 kg/m^3
Ambient Temperature：23.5 ℃; Liquid Temperature：22.5 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3857; ConvF(7.7, 7.7, 7.7); Calibrated: 2017.5.26;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1210; Calibrated: 2017.5.25
- Phantom: SAM4; Type: SAM; Serial: TP-1127
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch6/Area Scan (51x101x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 0.703 W/kg

Ch6/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 5.367 V/m; Power Drift = -0.09 dB
Peak SAR (extrapolated) = 0.753 W/kg
SAR(1 g) = 0.496 W/kg; SAR(10 g) = 0.276 W/kg
Maximum value of SAR (measured) = 0.655 W/kg



0 dB = 0.655 W/kg = -1.84 dBW/kg

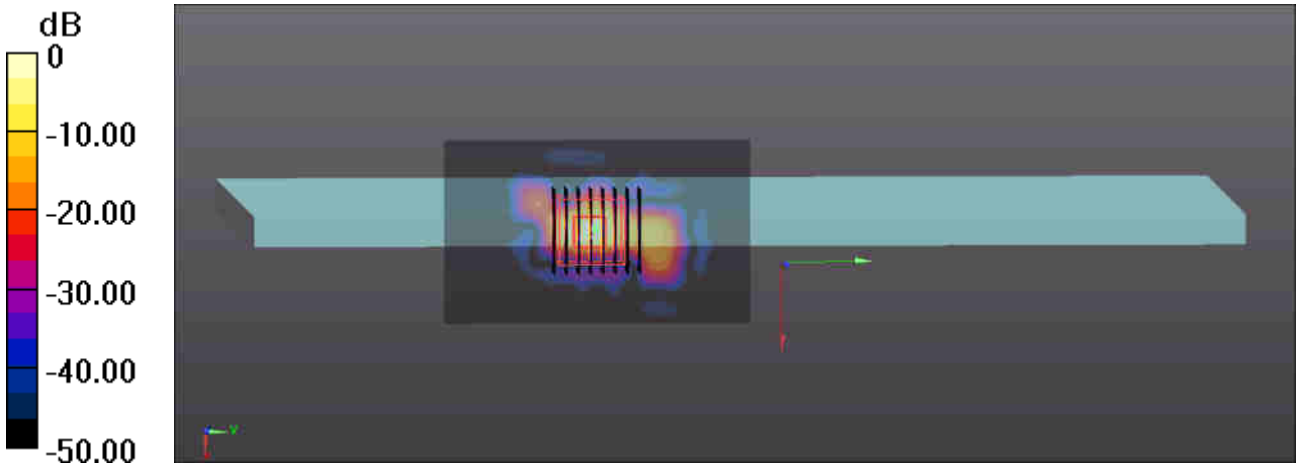
03_WLAN5.3GHz_802.11ac-VHT80 MCS0_Edge3_0mm_Ant.1_Ch58_Sensor On

Communication System: UID 0, WIFI (0); Frequency: 5290 MHz;Duty Cycle: 1:1.052
Medium: MSL_5000 Medium parameters used: f = 5290 MHz; σ = 5.405 S/m; ε_r = 48.347; ρ = 1000 kg/m^3
Ambient Temperature：23.6 ℃; Liquid Temperature：22.6 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3857; ConvF(4.72, 4.72, 4.72); Calibrated: 2017.5.26;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1210; Calibrated: 2017.5.25
- Phantom: SAM4; Type: SAM; Serial: TP-1127
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch58/Area Scan (61x101x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 3.65 W/kg

Ch58/Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 0 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 7.44 W/kg
SAR(1 g) = 1.04 W/kg; SAR(10 g) = 0.168 W/kg
Maximum value of SAR (measured) = 3.77 W/kg



0 dB = 3.77 W/kg = 5.76 dBW/kg

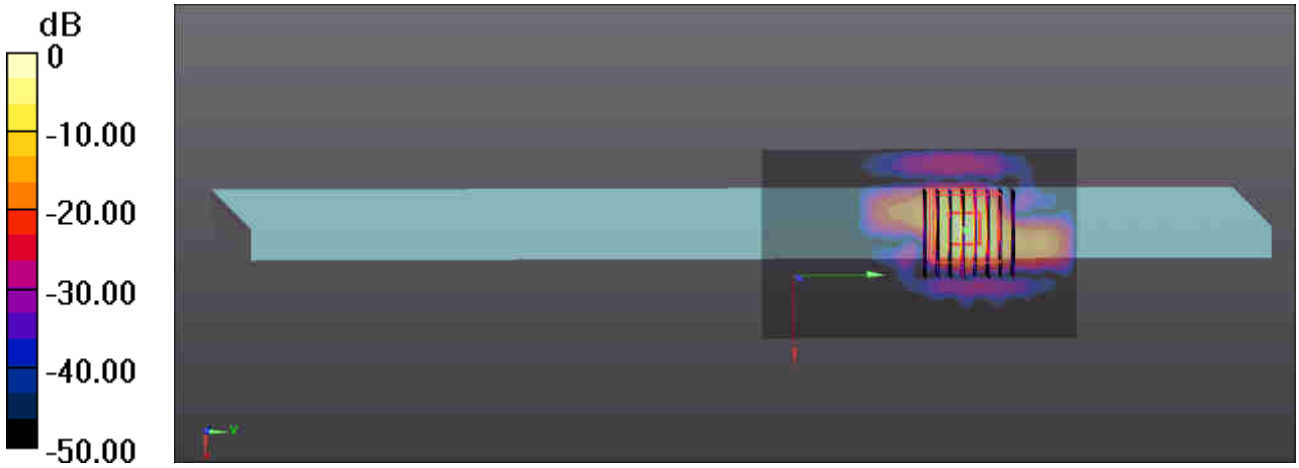
04_WLAN5.3GHz_802.11ac-VHT80 MCS0_Edge 3_0mm_Ant.2_Ch58_Sensor On

Communication System: UID 0, WIFI (0); Frequency: 5290 MHz;Duty Cycle: 1:1.052
Medium: MSL_5000 Medium parameters used: f = 5290 MHz; σ = 5.405 S/m; ε_r = 48.347; ρ = 1000 kg/m^3
Ambient Temperature：23.6 ℃; Liquid Temperature：22.6 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3857; ConvF(4.72, 4.72, 4.72); Calibrated: 2017.5.26;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1210; Calibrated: 2017.5.25
- Phantom: SAM4; Type: SAM; Serial: TP-1127
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch58/Area Scan (61x101x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.762 W/kg

Ch58/Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 0 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 6.67 W/kg
SAR(1 g) = 0.937 W/kg; SAR(10 g) = 0.149 W/kg
Maximum value of SAR (measured) = 3.07 W/kg



0 dB = 3.07 W/kg = 4.87 dBW/kg

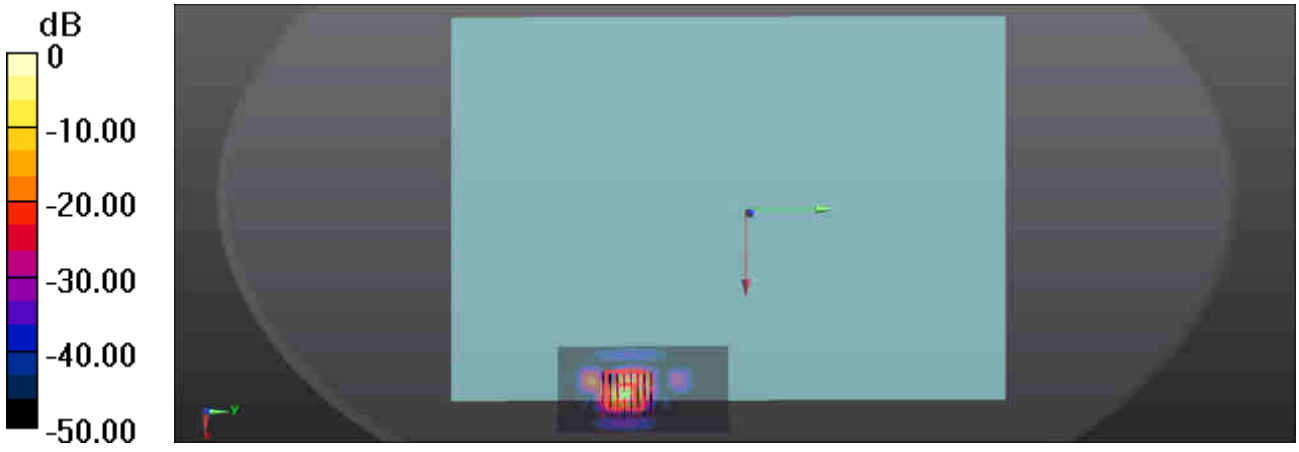
05_WLAN5.5GHz_802.11ac-VHT80 MCS0_Curved of Edge 3_0mm_Ant.1_Ch122_Sensor On

Communication System: UID 0, WIFI (0); Frequency: 5610 MHz;Duty Cycle: 1:1.052
Medium: MSL_5000 Medium parameters used: f = 5610 MHz; σ = 5.864 S/m; ε_r = 47.639; ρ = 1000 kg/m^3
Ambient Temperature：23.4 ℃; Liquid Temperature：22.7 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3857; ConvF(4.01, 4.01, 4.01); Calibrated: 2017.5.26;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1210; Calibrated: 2017.5.25
- Phantom: SAM4; Type: SAM; Serial: TP-1127
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch122/Area Scan (51x101x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 2.66 W/kg

Ch122/Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 0.6230 V/m; Power Drift = -0.09 dB
Peak SAR (extrapolated) = 7.04 W/kg
SAR(1 g) = 0.966 W/kg; SAR(10 g) = 0.153 W/kg
Maximum value of SAR (measured) = 3.67 W/kg



0 dB = 3.67 W/kg = 5.65 dBW/kg

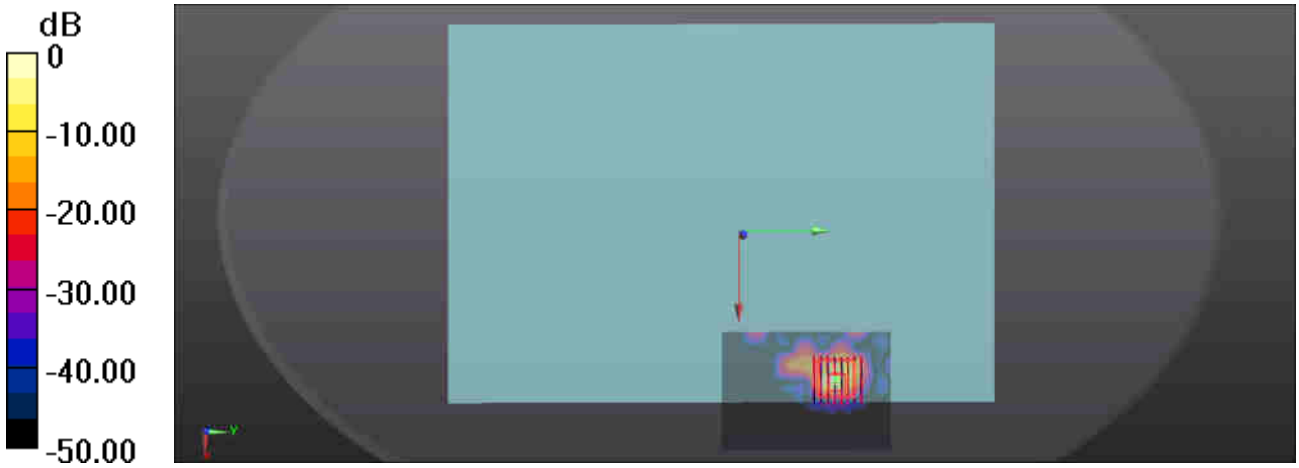
06_WLAN5.5GHz_802.11ac-VHT80 MCS0_Curved of Edge 3_0mm_Ant 2_Ch106_Sensor On

Communication System: UID 0, WIFI (0); Frequency: 5530 MHz;Duty Cycle: 1:1.052
Medium: MSL_5000 Medium parameters used: f = 5530 MHz; σ = 5.752 S/m; ε_r = 47.847; ρ = 1000 kg/m^3
Ambient Temperature：23.4 ℃; Liquid Temperature：22.7 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3857; ConvF(4.01, 4.01, 4.01); Calibrated: 2017.5.26;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1210; Calibrated: 2017.5.25
- Phantom: SAM4; Type: SAM; Serial: TP-1127
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch106/Area Scan (71x101x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 5.45 W/kg

Ch106/Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 0.8900 V/m; Power Drift = 0.09 dB
Peak SAR (extrapolated) = 7.19 W/kg
SAR(1 g) = 1.06 W/kg; SAR(10 g) = 0.182 W/kg
Maximum value of SAR (measured) = 4.02 W/kg



0 dB = 4.02 W/kg = 6.04 dBW/kg

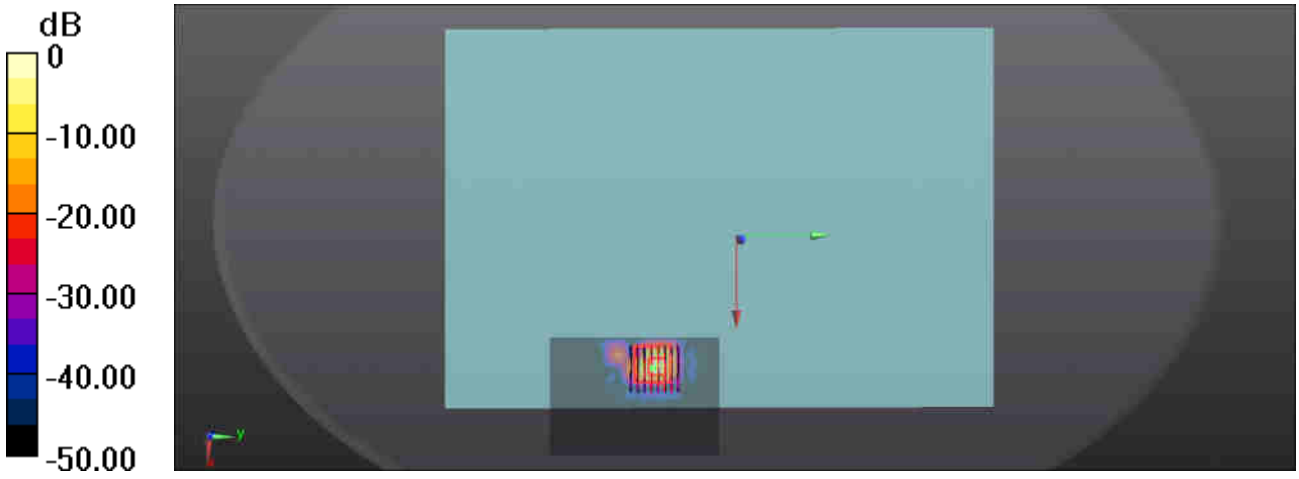
07_WLAN5.8GHz_802.11ac-VHT80 MCS0_Curved of Edge 3_0mm_Ant.1_Ch155_Sensor On

Communication System: UID 0, WIFI (0); Frequency: 5775 MHz;Duty Cycle: 1:1.052
Medium: MSL_5000 Medium parameters used: f = 5775 MHz; σ = 6.085 S/m; ε_r = 47.252; ρ = 1000 kg/m^3
Ambient Temperature：23.5 ℃; Liquid Temperature：22.8 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3857; ConvF(4.31, 4.31, 4.31); Calibrated: 2017.5.26;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1210; Calibrated: 2017.5.25
- Phantom: SAM4; Type: SAM; Serial: TP-1127
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch155/Area Scan (71x101x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 2.48 W/kg

Ch155/Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 0.8220 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 5.08 W/kg
SAR(1 g) = 0.701 W/kg; SAR(10 g) = 0.110 W/kg
Maximum value of SAR (measured) = 2.59 W/kg



0 dB = 2.59 W/kg = 4.13 dBW/kg

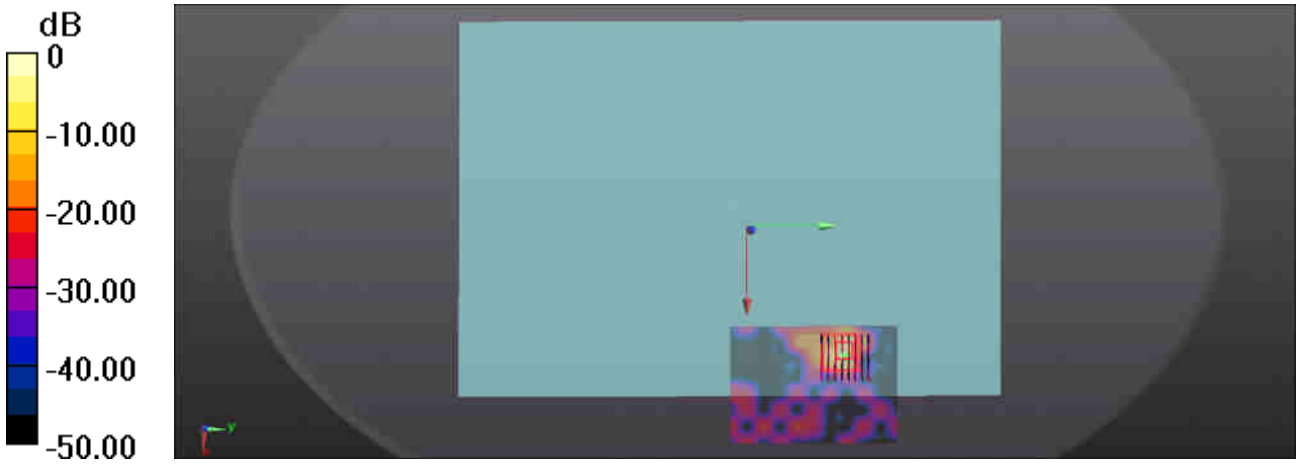
08_WLAN5.8GHz_802.11ac-VHT80 MCS0_Curved of Edge 3_0mm_Ant 2_Ch155_Sensor On

Communication System: UID 0, WIFI (0); Frequency: 5775 MHz;Duty Cycle: 1:1.052
Medium: MSL_5000 Medium parameters used: f = 5775 MHz; σ = 6.085 S/m; ε_r = 47.252; ρ = 1000 kg/m^3
Ambient Temperature：23.5 ℃; Liquid Temperature：22.8 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3857; ConvF(4.31, 4.31, 4.31); Calibrated: 2017.5.26;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1210; Calibrated: 2017.5.25
- Phantom: SAM4; Type: SAM; Serial: TP-1127
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch155/Area Scan (71x101x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 3.03 W/kg

Ch155/Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 0.8340 V/m; Power Drift = -0.09 dB
Peak SAR (extrapolated) = 8.52 W/kg
SAR(1 g) = 1.02 W/kg; SAR(10 g) = 0.159 W/kg
Maximum value of SAR (measured) = 3.94 W/kg



0 dB = 3.94 W/kg = 5.95 dBW/kg

Test Laboratory: Sporton International Inc. SAR/HAC Testing Lab Date: 2017.6.25

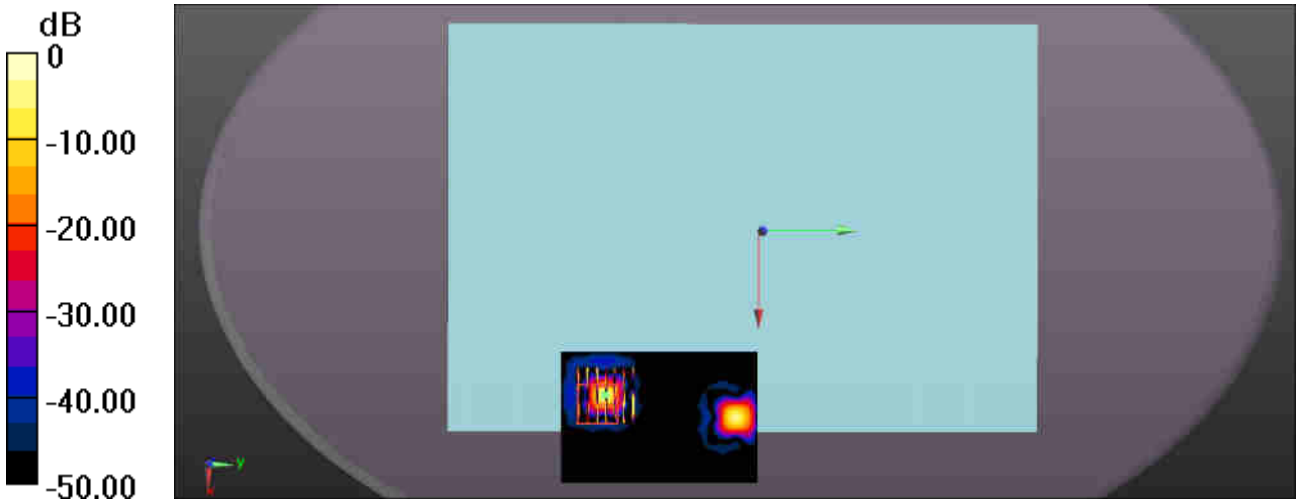
09_Bluetooth_DH5 1Mbps_Curved of Edge 3_0mm_Ant 1_Ch78

Communication System: UID 0, Bluetooth (0); Frequency: 2480 MHz;Duty Cycle: 1:1.3
Medium: MSL_2450 Medium parameters used: f = 2480 MHz; σ = 2.03 S/m; ε_r = 51.773; ρ = 1000 kg/m^3
Ambient Temperature：23.5 ℃； Liquid Temperature：22.5 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3857; ConvF(7.7, 7.7, 7.7); Calibrated: 2017.5.26;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1210; Calibrated: 2017.5.25
- Phantom: SAM4; Type: SAM; Serial: TP-1127
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch78/Area Scan (61x91x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 0.00445 W/kg

Ch78/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 0.7090 V/m; Power Drift = 0.08 dB
Peak SAR (extrapolated) = 0.0160 W/kg
SAR(1 g) = 0.00361 W/kg; SAR(10 g) = 2.38e-005 W/kg
Maximum value of SAR (measured) = 0.00904 W/kg



0 dB = 0.00904 W/kg = -20.44 dBW/kg

Appendix C. DASY Calibration Certificate

The DASY calibration certificates are shown as follows.

In Collaboration with
s p e a g
CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com Http://www.chinattl.cn

中国认可
国际互认
校准
CALIBRATION
CNAS L0570

Client **Sporton-CN** **Certificate No: Z16-97231**

CALIBRATION CERTIFICATE

Object D2450V2 - SN: 840

Calibration Procedure(s) FD-Z11-003-01
Calibration Procedures for dipole validation kits

Calibration date: November 25, 2016

This calibration Certificate documents the traceability to national standards, which realize the physical units of measurements(SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature(22±3)℃ and humidity<70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Power Meter NRP2	101919	27-Jun-16 (CTTL, No.J16X04777)	Jun-17
Power sensor NRP-Z91	101547	27-Jun-16 (CTTL, No.J16X04777)	Jun-17
Reference Probe EX3DV4	SN 7433	26-Sep-16(SPEAG,No.EX3-7433_Sep16)	Sep-17
DAE4	SN 771	02-Feb-16(CTTL-SPEAG,No.Z16-97011)	Feb-17
Secondary Standards	**ID #**	**Cal Date(Calibrated by, Certificate No.)**	**Scheduled Calibration**
Signal Generator E4438C	MY49071430	01-Feb-16 (CTTL, No.J16X00893)	Jan-17
Network Analyzer E5071C	MY46110673	26-Jan-16 (CTTL, No.J16X00894)	Jan-17

	Name	Function	Signature
Calibrated by:	Zhao Jing	SAR Test Engineer	
Reviewed by:	Qi Dianyuan	SAR Project Leader	
Approved by:	Lu Bingsong	Deputy Director of the laboratory	

Issued: November 27, 2016

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Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORMx,y,z
N/A	not applicable or not measured

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013

b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) For hand-held devices used in close proximity to the ear (frequency range of 300MHz to 3GHz)", February 2005

c) IEC 62209-2, "Procedure to measure the Specific Absorption Rate (SAR) For wireless communication devices used in close proximity to the human body (frequency range of 30MHz to 6GHz)", March 2010

d) KDB865664, SAR Measurement Requirements for 100 MHz to 6 GHz

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

- *Measurement Conditions:* Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- *Antenna Parameters with TSL:* The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- *Feed Point Impedance and Return Loss:* These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- *Electrical Delay:* One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- *SAR measured:* SAR measured at the stated antenna input power.
- *SAR normalized:* SAR as measured, normalized to an input power of 1 W at the antenna connector.
- *SAR for nominal TSL parameters:* The measured TSL parameters are used to calculate the nominal SAR result.

The reported uncertainty of measurement is stated as the standard uncertainty of Measurement multiplied by the coverage factor k=2, which for a normal distribution Corresponds to a coverage probability of approximately 95%.

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Measurement Conditions

DASY system configuration, as far as not given on page 1.

DASY Version	DASY52	52.8.8.1258
Extrapolation	Advanced Extrapolation	
Phantom	Triple Flat Phantom 5.1C	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2450 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	38.9 ± 6 %	1.79 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.5 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**54.0 mW /g ± 20.8 % (k=2)**
SAR averaged over 10 cm^3 (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	6.33 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**25.3 mW /g ± 20.4 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	52.7	1.95 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	52.3 ± 6 %	1.97 mho/m ± 6 %
Body TSL temperature change during test	<1.0 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	12.8 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**50.9 mW /g ± 20.8 % (k=2)**
SAR averaged over 10 cm^3 (10 g) of Body TSL	Condition	
SAR measured	250 mW input power	6.02 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**24.0 mW /g ± 20.4 % (k=2)**

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Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	51.7Ω+ 5.54jΩ
Return Loss	- 24.9dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	49.8Ω+ 6.00jΩ
Return Loss	- 24.4dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.045 ns

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.
No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG

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DASY5 Validation Report for Head TSL Date: 11.25.2016

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 840

Communication System: UID 0, CW; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium parameters used: f = 2450 MHz; σ = 1.793 S/m; εr = 38.86; ρ = 1000 kg/m3

Phantom section: Center Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: EX3DV4 - SN7433; ConvF(7.45, 7.45, 7.45); Calibrated: 9/26/2016;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn771; Calibrated: 2/2/2016
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/1
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7372)

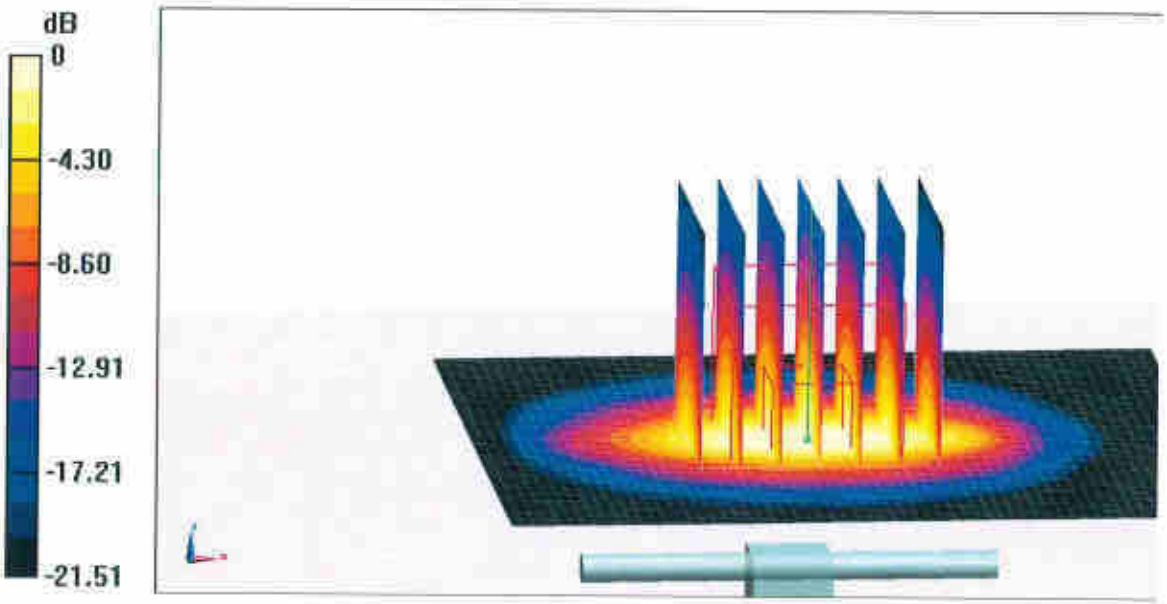
Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 107.5 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 27.5 W/kg

SAR(1 g) = 13.5 W/kg; SAR(10 g) = 6.33 W/kg

Maximum value of SAR (measured) = 20.5 W/kg



0 dB = 20.5 W/kg = 13.12 dBW/kg

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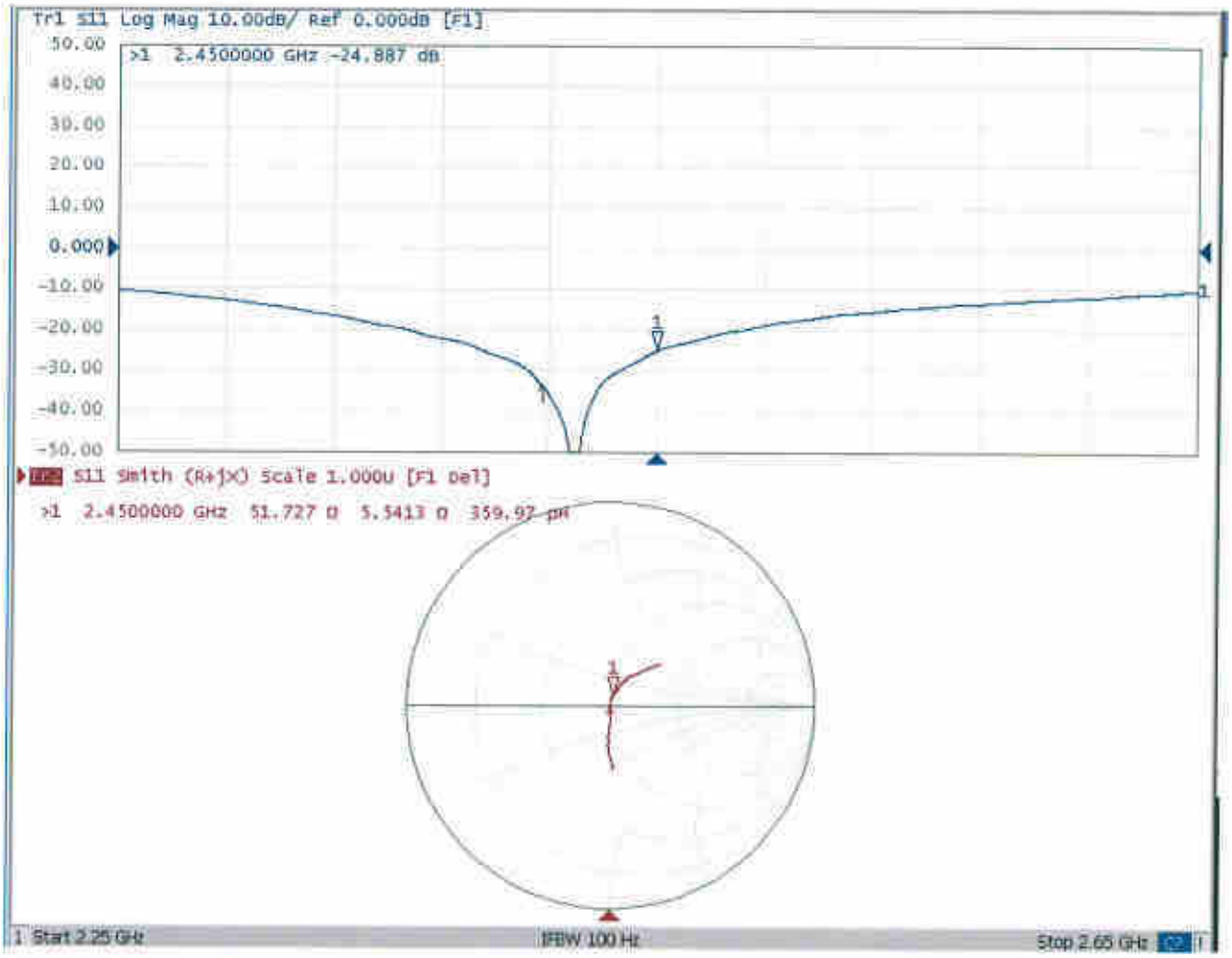
Impedance Measurement Plot for Head TSL



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DASY5 Validation Report for Body TSL Date: 11.24.2016

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 840

Communication System: UID 0, CW; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium parameters used: f = 2450 MHz; σ = 1.966 S/m; ε_r = 52.29; ρ = 1000 kg/m^3

Phantom section: Left Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: EX3DV4 - SN7433; ConvF(7.46, 7.46, 7.46); Calibrated: 9/26/2016;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn771; Calibrated: 2/2/2016
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/1
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7372)

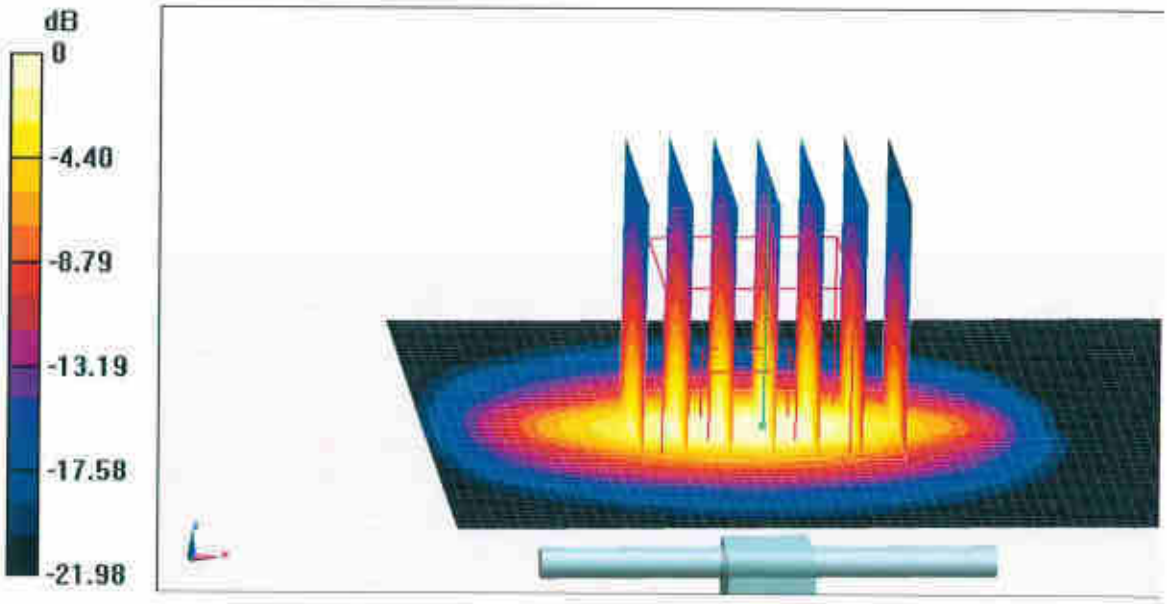
Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 99.46 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 25.9 W/kg

SAR(1 g) = 12.8 W/kg; SAR(10 g) = 6.02 W/kg

Maximum value of SAR (measured) = 19.2 W/kg



0 dB = 19.2 W/kg = 12.83 dBW/kg

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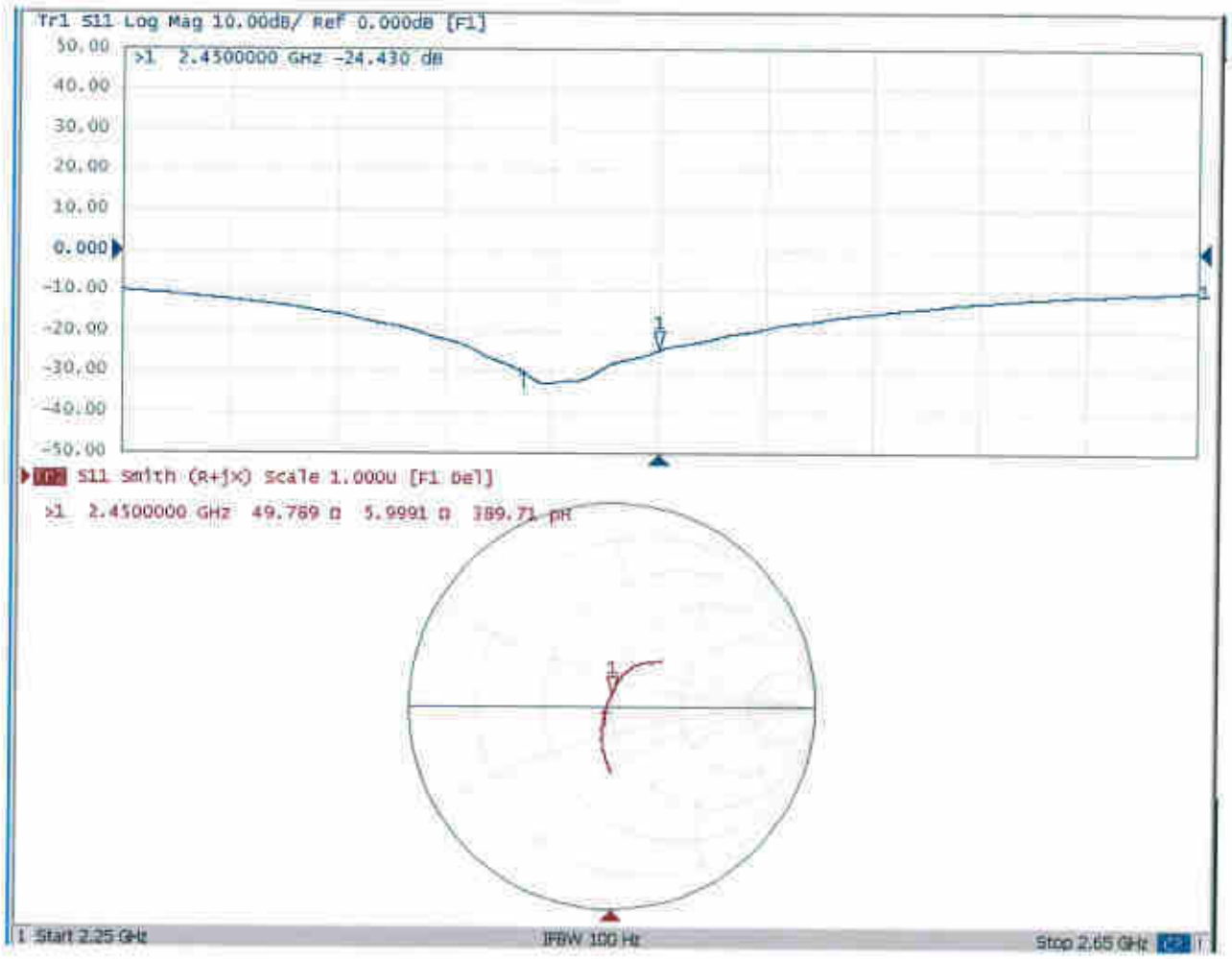
Impedance Measurement Plot for Body TSL



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CNAS L0570

Client **Sporton-CN** **Certificate No: Z16-97234**

CALIBRATION CERTIFICATE

Object	D5GHzV2 - SN: 1113
Calibration Procedure(s)	FD-Z11-003-01 Calibration Procedures for dipole validation kits
Calibration date:	December 13, 2016

This calibration Certificate documents the traceability to national standards, which realize the physical units of measurements(SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature(22±3)℃ and humidity<70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Power Meter NRP2	101919	27-Jun-16 (CTTL, No.J16X04777)	Jun-17
Power sensor NRP-Z91	101547	27-Jun-16 (CTTL, No.J16X04777)	Jun-17
ReferenceProbe EX3DV4	SN 7307	19-Feb-16(SPEAG,No.EX3-7307_Feb16)	Feb-17
DAE4	SN 771	02-Feb-16(CTTL-SPEAG,No.Z16-97011)	Feb-17
Secondary Standards	**ID #**	**Cal Date(Calibrated by, Certificate No.)**	**Scheduled Calibration**
Signal Generator E4438C	MY49071430	01-Feb-16 (CTTL, No.J16X00893)	Jan-17
NetworkAnalyzer E5071C	MY46110673	26-Jan-16 (CTTL, No.J16X00894)	Jan-17

	Name	Function	Signature
Calibrated by:	Zhao Jing	SAR Test Engineer	
Reviewed by:	Qi Dianyuan	SAR Project Leader	
Approved by:	Lu Bingsong	Deputy Director of the laboratory	

Issued: December 15, 2016

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Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORMx,y,z
N/A	not applicable or not measured

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013

b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) For hand-held devices used in close proximity to the ear (frequency range of 300MHz to 3GHz)", February 2005

c) IEC 62209-2, "Procedure to measure the Specific Absorption Rate (SAR) For wireless communication devices used in close proximity to the human body (frequency range of 30MHz to 6GHz)", March 2010

d) KDB865664, SAR Measurement Requirements for 100 MHz to 6 GHz

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

- *Measurement Conditions:* Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- *Antenna Parameters with TSL:* The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- *Feed Point Impedance and Return Loss:* These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- *Electrical Delay:* One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- *SAR measured:* SAR measured at the stated antenna input power.
- *SAR normalized:* SAR as measured, normalized to an input power of 1 W at the antenna connector.
- *SAR for nominal TSL parameters:* The measured TSL parameters are used to calculate the nominal SAR result.

The reported uncertainty of measurement is stated as the standard uncertainty of Measurement multiplied by the coverage factor k=2, which for a normal distribution Corresponds to a coverage probability of approximately 95%.

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Measurement Conditions

DASY system configuration, as far as not given on page 1.

DASY Version	DASY52	52.8.8.1258
Extrapolation	Advanced Extrapolation	
Phantom	Triple Flat Phantom 5.1C	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy = 4 mm, dz = 1.4 mm	Graded Ratio = 1.4 (Z direction)
Frequency	5250 MHz ± 1 MHz 5600 MHz ± 1 MHz 5750 MHz ± 1 MHz	

Head TSL parameters at 5250 MHz

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	35.9	4.71 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	36.3 ± 6 %	4.72 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C	----	----

SAR result with Head TSL at 5250 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.62 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**76.4 mW /g ± 23.0 % (k=2)**
SAR averaged over 10 cm^3 (10 g) of Head TSL	Condition	
SAR measured	100 mW input power	2.17 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**21.8 mW /g ± 22.2 % (k=2)**

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Head TSL parameters at 5600 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.5	5.07 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	35.5 ± 6 %	5.17 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C	----	----

SAR result with Head TSL at 5600 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.07 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**80.8 mW /g ± 23.0 % (k=2)**
SAR averaged over 10 cm^3 (10 g) of Head TSL	Condition	
SAR measured	100 mW input power	2.30 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**23.0 mW /g ± 22.2 % (k=2)**

Head TSL parameters at 5750 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.4	5.22 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	35.2 ± 6 %	5.37 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C	----	----

SAR result with Head TSL at 5750 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.03 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**80.3 mW /g ± 23.0 % (k=2)**
SAR averaged over 10 cm^3 (10 g) of Head TSL	Condition	
SAR measured	100 mW input power	2.28 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**22.8 mW /g ± 22.2 % (k=2)**

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Body TSL parameters at 5250 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.9	5.36 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	47.9 ± 6 %	5.44 mho/m ± 6 %
Body TSL temperature change during test	<1.0 °C	----	----

SAR result with Body TSL at 5250 MHz

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.63 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**76.1 mW /g ± 23.0 % (k=2)**
SAR averaged over 10 cm^3 (10 g) of Body TSL	Condition	
SAR measured	100 mW input power	2.16 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**21.5 mW /g ± 22.2 % (k=2)**

Body TSL parameters at 5600 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.5	5.77 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	48.9 ± 6 %	5.74 mho/m ± 6 %
Body TSL temperature change during test	<1.0 °C	----	----

SAR result with Body TSL at 5600 MHz

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.97 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**79.8 mW /g ± 23.0 % (k=2)**
SAR averaged over 10 cm^3 (10 g) of Body TSL	Condition	
SAR measured	100 mW input power	2.25 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**22.6 mW /g ± 22.2 % (k=2)**

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Body TSL parameters at 5750 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.3	5.94 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	48.7 ± 6 %	5.91 mho/m ± 6 %
Body TSL temperature change during test	<1.0 °C	---	---

SAR result with Body TSL at 5750 MHz

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.51 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**75.2 mW /g ± 23.0 % (k=2)**
SAR averaged over 10 cm^3 (10 g) of Body TSL	Condition	
SAR measured	100 mW input power	2.11 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**21.1 mW /g ± 22.2 % (k=2)**

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Appendix

Antenna Parameters with Head TSL at 5250 MHz

Impedance, transformed to feed point	51.2Ω - 5.57jΩ
Return Loss	- 25.0dB

Antenna Parameters with Head TSL at 5600 MHz

Impedance, transformed to feed point	57.9Ω - 0.17jΩ
Return Loss	- 22.7dB

Antenna Parameters with Head TSL at 5750 MHz

Impedance, transformed to feed point	53.2Ω - 0.30jΩ
Return Loss	- 30.3dB

Antenna Parameters with Body TSL at 5250 MHz

Impedance, transformed to feed point	52.0Ω - 4.21jΩ
Return Loss	- 26.8dB

Antenna Parameters with Body TSL at 5600 MHz

Impedance, transformed to feed point	56.3Ω + 4.48jΩ
Return Loss	- 22.8dB

Antenna Parameters with Body TSL at 5750 MHz

Impedance, transformed to feed point	53.7Ω + 2.93jΩ
Return Loss	- 26.9dB

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General Antenna Parameters and Design

Electrical Delay (one direction)	1.301 ns

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.
No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG

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DASY5 Validation Report for Head TSL Date: 12.12.2016

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1113

Communication System: CW; Frequency: 5250 MHz, Frequency: 5600 MHz, Frequency: 5750 MHz,

Medium parameters used: f = 5250 MHz; σ = 4.724 mho/m; εr = 36.26; ρ = 1000 kg/m3, Medium parameters used: f = 5600 MHz; σ = 5.172 mho/m; εr = 35.54; ρ = 1000 kg/m3, Medium parameters used: f = 5750 MHz; σ = 5.371 mho/m; εr = 35.17; ρ = 1000 kg/m3,

Phantom section: Center Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: EX3DV4 - SN7307; ConvF(5.32,5.32,5.32); Calibrated: 2016/2/19, ConvF(4.52,4.52,4.52); Calibrated: 2016/2/19, ConvF(4.45,4.45,4.45); Calibrated: 2016/2/19,
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn771; Calibrated: 2016/2/2
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/3
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7372)

Dipole Calibration /Pin=100mW, d=10mm, f=5250 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 66.56 V/m; Power Drift = 0.00 dB

Peak SAR (extrapolated) = 31.1 W/kg

SAR(1 g) = 7.62 W/kg; SAR(10 g) = 2.17 W/kg

Maximum value of SAR (measured) = 17.6 W/kg

Dipole Calibration /Pin=100mW, d=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 70.62 V/m; Power Drift = 0.07 dB

Peak SAR (extrapolated) = 35.2 W/kg

SAR(1 g) = 8.07 W/kg; SAR(10 g) = 2.3 W/kg

Maximum value of SAR (measured) = 19.8 W/kg

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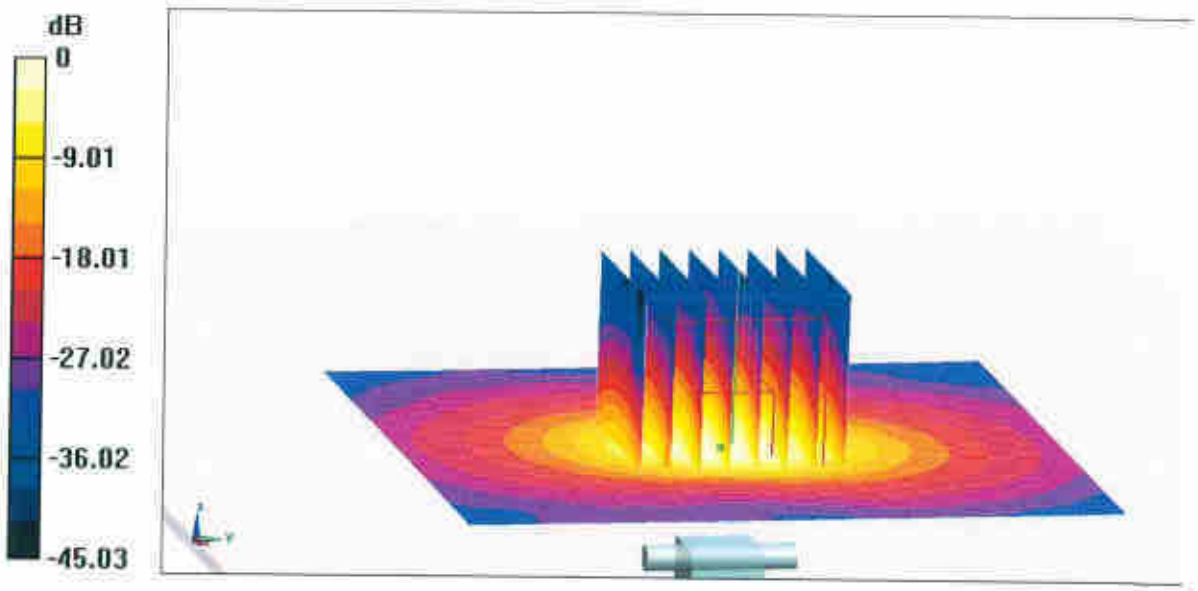
Dipole Calibration /Pin=100mW, d=10mm, f=5750 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 69.62 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 33.9 W/kg
SAR(1 g) = 8.03 W/kg; SAR(10 g) = 2.28 W/kg
Maximum value of SAR (measured) = 19.6 W/kg



0 dB = 19.6 W/kg = 12.92 dBW/kg

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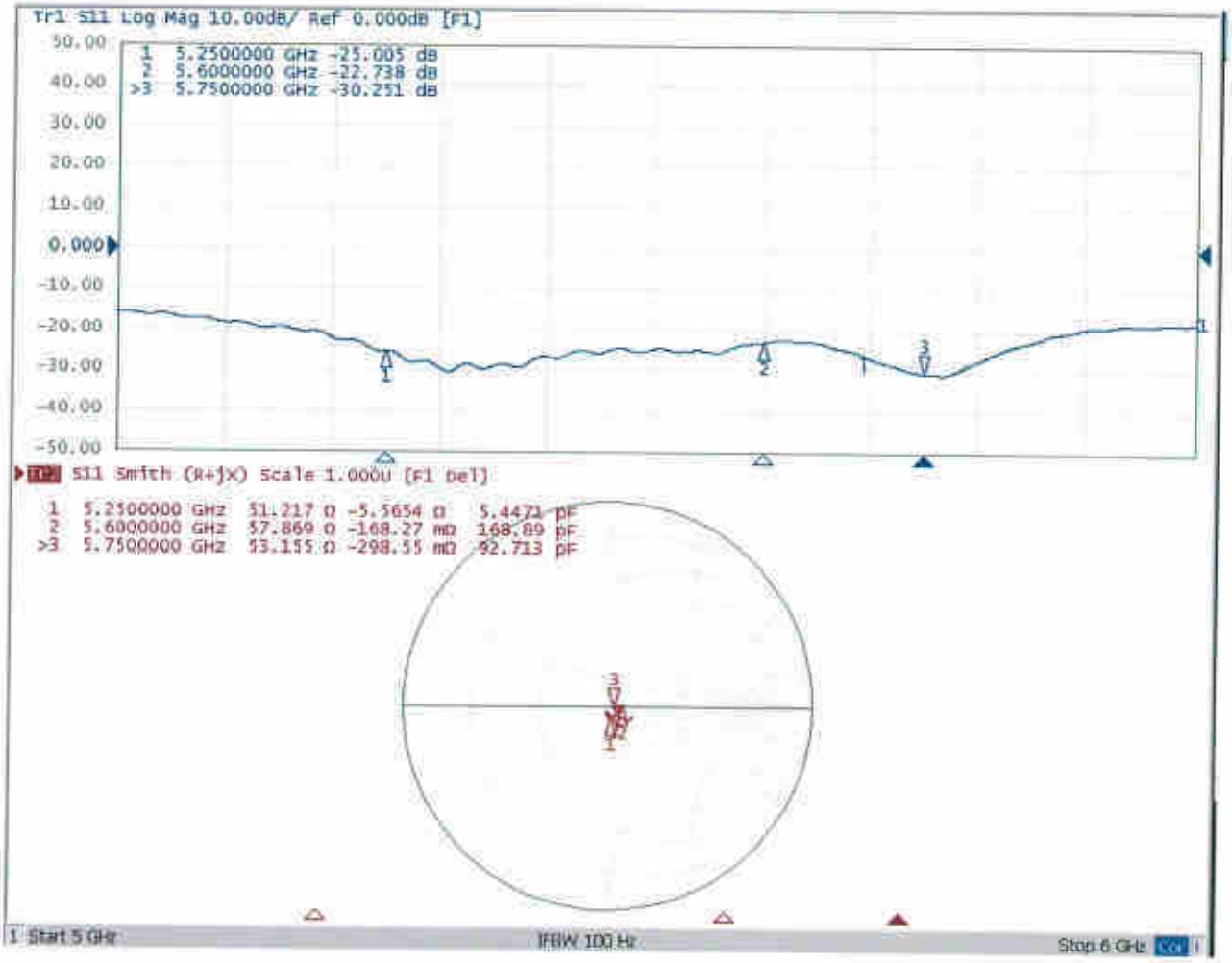
Impedance Measurement Plot for Head TSL



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DASY5 Validation Report for Body TSL Date: 12.13.2016

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1113

Communication System: CW; Frequency: 5250 MHz, Frequency: 5600 MHz, Frequency: 5750 MHz,

Medium parameters used: f = 5250 MHz; σ = 5.442 mho/m; εr = 47.93; ρ = 1000 kg/m3, Medium parameters used: f = 5600 MHz; σ = 5.74 mho/m; εr = 48.92; ρ = 1000 kg/m3, Medium parameters used: f = 5750 MHz; σ = 5.91 mho/m; εr = 48.73; ρ = 1000 kg/m3,

Phantom section: Right Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: EX3DV4 - SN7307; ConvF(4.48,4.48,4.48); Calibrated: 2016/2/19, ConvF(3.72,3.72,3.72); Calibrated: 2016/2/19, ConvF(3.91,3.91,3.91); Calibrated: 2016/2/19,
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn771; Calibrated: 2016/2/2
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/3
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7372)

Dipole Calibration /Pin=100mW, d=10mm, f=5250 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 50.72 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 29.1 W/kg
SAR(1 g) = 7.63 W/kg; SAR(10 g) = 2.16 W/kg
Maximum value of SAR (measured) = 17.9 W/kg

Dipole Calibration /Pin=100mW, d=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 58.44 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 30.7 W/kg
SAR(1 g) = 7.97 W/kg; SAR(10 g) = 2.25 W/kg
Maximum value of SAR (measured) = 18.3 W/kg

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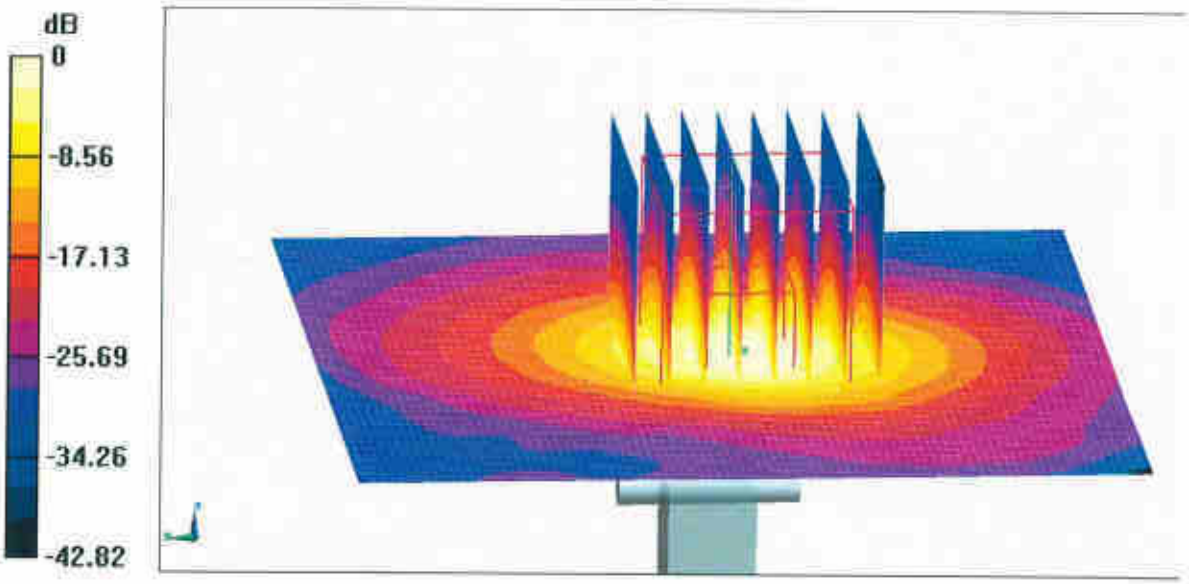
Dipole Calibration /Pin=100mW, d=10mm, f=5750 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 61.59 V/m; Power Drift = 0.05 dB
Peak SAR (extrapolated) = 31.1 W/kg
SAR(1 g) = 7.51 W/kg; SAR(10 g) = 2.11 W/kg
Maximum value of SAR (measured) = 18.5 W/kg



0 dB = 18.5 W/kg = 12.67 dBW/kg

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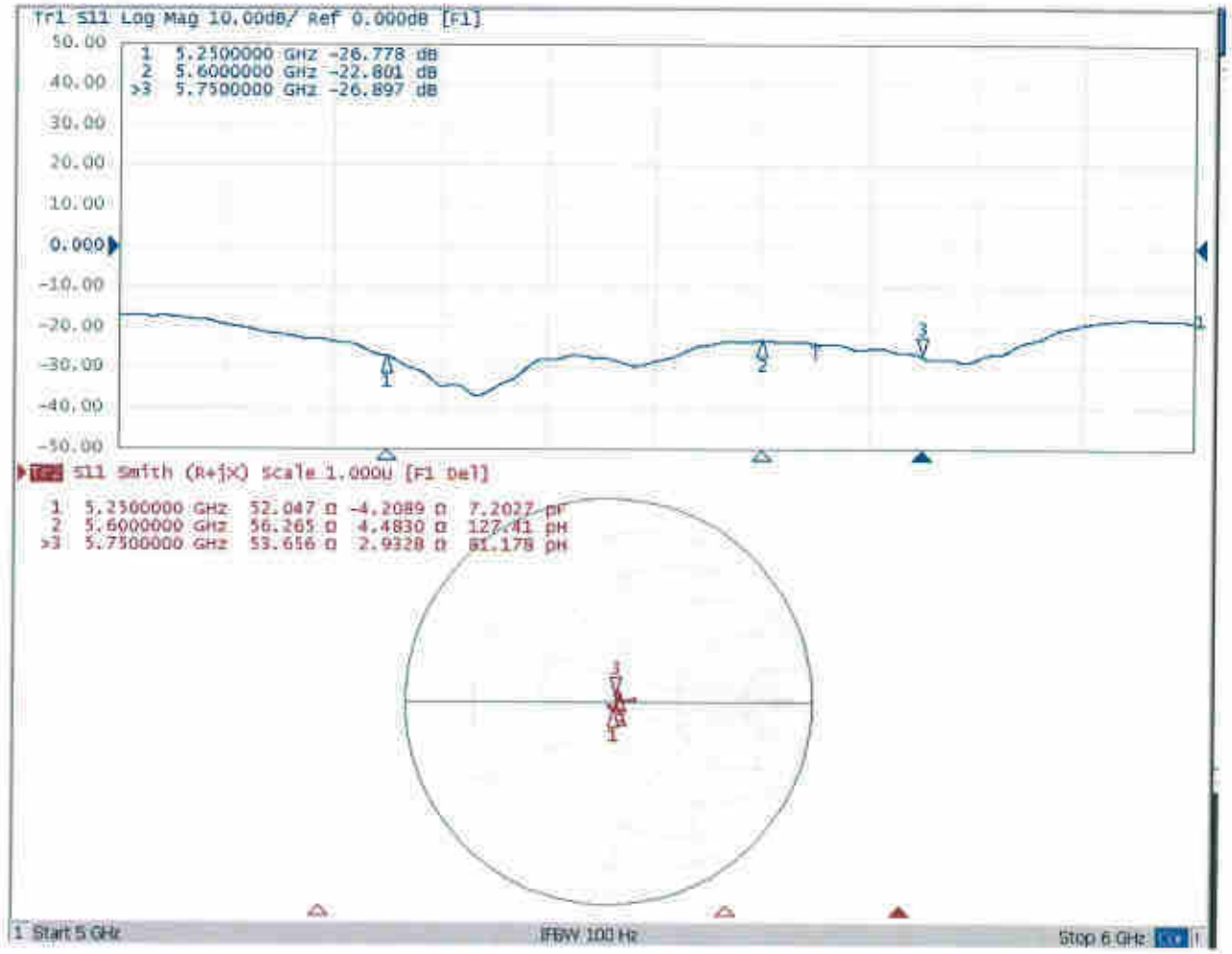
Impedance Measurement Plot for Body TSL



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CNAS L0570

Client : **Sporton** **Certificate No: Z17-97069**

CALIBRATION CERTIFICATE

Object	DAE4 - SN: 1210
Calibration Procedure(s)	FF-Z11-002-01 Calibration Procedure for the Data Acquisition Electronics (DAEx)
Calibration date:	May 25, 2017

This calibration Certificate documents the traceability to national standards, which realize the physical units of measurements(SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature(22±3)℃ and humidity<70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Process Calibrator 753	1971018	27-June-16 (CTTL, No:J16X04778)	June-17

	Name	Function	Signature
Calibrated by:	Yu Zongying	SAR Test Engineer	
Reviewed by:	Lin Hao	SAR Test Engineer	
Approved by:	Qi Dianyuan	SAR Project Leader	

Issued: May 26, 2017

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
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Glossary:

DAE	data acquisition electronics
Connector angle	information used in DASY system to align probe sensor X to the robot coordinate system.

Methods Applied and Interpretation of Parameters:

- *DC Voltage Measurement*: Calibration Factor assessed for use in DASY system by comparison with a calibrated instrument traceable to national standards. The figure given corresponds to the full scale range of the voltmeter in the respective range.

- *Connector angle*: The angle of the connector is assessed measuring the angle mechanically by a tool inserted. Uncertainty is not required.

- The report provide only calibration results for DAE, it does not contain other performance test results.

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DC Voltage Measurement

A/D - Converter Resolution nominal

High Range: 1LSB = 6.1μV , full range = -100...+300 mV
Low Range: 1LSB = 61nV , full range = -1.....+3mV

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

Calibration Factors	X	Y	Z
High Range	404.098 ± 0.15% (k=2)	404.921 ± 0.15% (k=2)	405.031 ± 0.15% (k=2)
Low Range	3.99972 ± 0.7% (k=2)	3.98407 ± 0.7% (k=2)	4.00010 ± 0.7% (k=2)

Connector Angle

Connector Angle to be used in DASY system	123° ± 1 °

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Accreditation No.: SCS 0108

Client **Sporton (Auden)** **Certificate No: EX3-3857_May17**

CALIBRATION CERTIFICATE

Object EX3DV4 - SN:3857

Calibration procedure(s) QA CAL-01.v9, QA CAL-14.v4, QA CAL-23.v5, QA CAL-25.v6
Calibration procedure for dosimetric E-field probes

Calibration date: May 26, 2017

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	04-Apr-17 (No. 217-02521/02522)	Apr-18
Power sensor NRP-Z91	SN: 103244	04-Apr-17 (No. 217-02521)	Apr-18
Power sensor NRP-Z91	SN: 103245	04-Apr-17 (No. 217-02525)	Apr-18
Reference 20 dB Attenuator	SN: S5277 (20x)	07-Apr-17 (No. 217-02528)	Apr-18
Reference Probe ES3DV2	SN: 3013	31-Dec-16 (No. ES3-3013_Dec16)	Dec-17
DAE4	SN: 660	7-Dec-16 (No. DAE4-660_Dec16)	Dec-17
Secondary Standards	ID	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB41293874	06-Apr-16 (in house check Jun-16)	In house check: Jun-18
Power sensor E4412A	SN: MY41498087	06-Apr-16 (in house check Jun-16)	In house check: Jun-18
Power sensor E4412A	SN: 000110210	06-Apr-16 (in house check Jun-16)	In house check: Jun-18
RF generator HP 8648C	SN: US3642U01700	04-Aug-99 (in house check Jun-16)	In house check: Jun-18
Network Analyzer HP 8753E	SN: US37390585	18-Oct-01 (in house check Oct-16)	In house check: Oct-17

	Name	Function	Signature
Calibrated by:	Michael Weber	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: May 30, 2017

Calibration Laboratory of
Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

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Accreditation No.: SCS 0108

Glossary:

TSL	tissue simulating liquid
NORMx,y,z	sensitivity in free space
ConvF	sensitivity in TSL / NORMx,y,z
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C, D	modulation dependent linearization parameters
Polarization φ	φ rotation around probe axis
Polarization ϑ	ϑ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., ϑ = 0 is normal to probe axis
Connector Angle	information used in DASY system to align probe sensor X to the robot coordinate system

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Methods Applied and Interpretation of Parameters:

- *NORMx,y,z:* Assessed for E-field polarization ϑ = 0 (f ≤ 900 MHz in TEM-cell; f > 1800 MHz: R22 waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not affect the E^2-field uncertainty inside TSL (see below *ConvF*).
- *NORM(f)x,y,z = NORMx,y,z * frequency_response* (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of *ConvF*.
- *DCPx,y,z:* DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- *PAR:* PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- *Ax,y,z; Bx,y,z; Cx,y,z; Dx,y,z; VRx,y,z: A, B, C, D* are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. *VR* is the maximum calibration range expressed in RMS voltage across the diode.
- *ConvF and Boundary Effect Parameters:* Assessed in flat phantom using E-field (or Temperature Transfer Standard for f ≤ 800 MHz) and inside waveguide using analytical field distributions based on power measurements for f > 800 MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to *NORMx,y,z * ConvF* whereby the uncertainty corresponds to that given for *ConvF*. A frequency dependent *ConvF* is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- *Spherical isotropy (3D deviation from isotropy)*: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- *Sensor Offset*: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- *Connector Angle*: The angle is assessed using the information gained by determining the *NORMx* (no uncertainty required).

Probe EX3DV4

SN:3857

Manufactured: January 23, 2012
Calibrated: May 26, 2017

Calibrated for DASY/EASY Systems
(Note: non-compatible with DASY2 system!)

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3857

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	0.17	0.42	0.44	± 10.1 %
DCP (mV)[B]	98.5	100.1	102.4	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB√μV	C	D dB	VR mV	Unc[E] (k=2)
0	CW	X	0.0	0.0	1.0	0.00	139.2	±3.8 %
		Y	0.0	0.0	1.0		147.4	
		Z	0.0	0.0	1.0		144.9	

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

[A] The uncertainties of Norm X,Y,Z do not affect the E^2-field uncertainty inside TSL (see Pages 5 and 6).
[B] Numerical linearization parameter: uncertainty not required.
[E] Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3857

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unc (k=2)
750	41.9	0.89	10.01	10.01	10.01	0.39	0.99	± 12.0 %
835	41.5	0.90	9.73	9.73	9.73	0.47	0.85	± 12.0 %
900	41.5	0.97	9.48	9.48	9.48	0.31	1.01	± 12.0 %
1750	40.1	1.37	8.47	8.47	8.47	0.38	0.82	± 12.0 %
1900	40.0	1.40	8.29	8.29	8.29	0.38	0.80	± 12.0 %
2000	40.0	1.40	8.26	8.26	8.26	0.35	0.80	± 12.0 %
2300	39.5	1.67	7.95	7.95	7.95	0.24	1.08	± 12.0 %
2450	39.2	1.80	7.71	7.71	7.71	0.41	0.80	± 12.0 %
2600	39.0	1.96	7.62	7.62	7.62	0.41	0.90	± 12.0 %
3500	37.9	2.91	7.37	7.37	7.37	0.29	1.25	± 13.1 %
3700	37.7	3.12	6.94	6.94	6.94	0.25	1.25	± 13.1 %
5250	35.9	4.71	5.39	5.39	5.39	0.35	1.80	± 13.1 %
5600	35.5	5.07	5.04	5.04	5.04	0.40	1.80	± 13.1 %
5750	35.4	5.22	5.34	5.34	5.34	0.40	1.80	± 13.1 %

[C] Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.

[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3857

Calibration Parameter Determined in Body Tissue Simulating Media

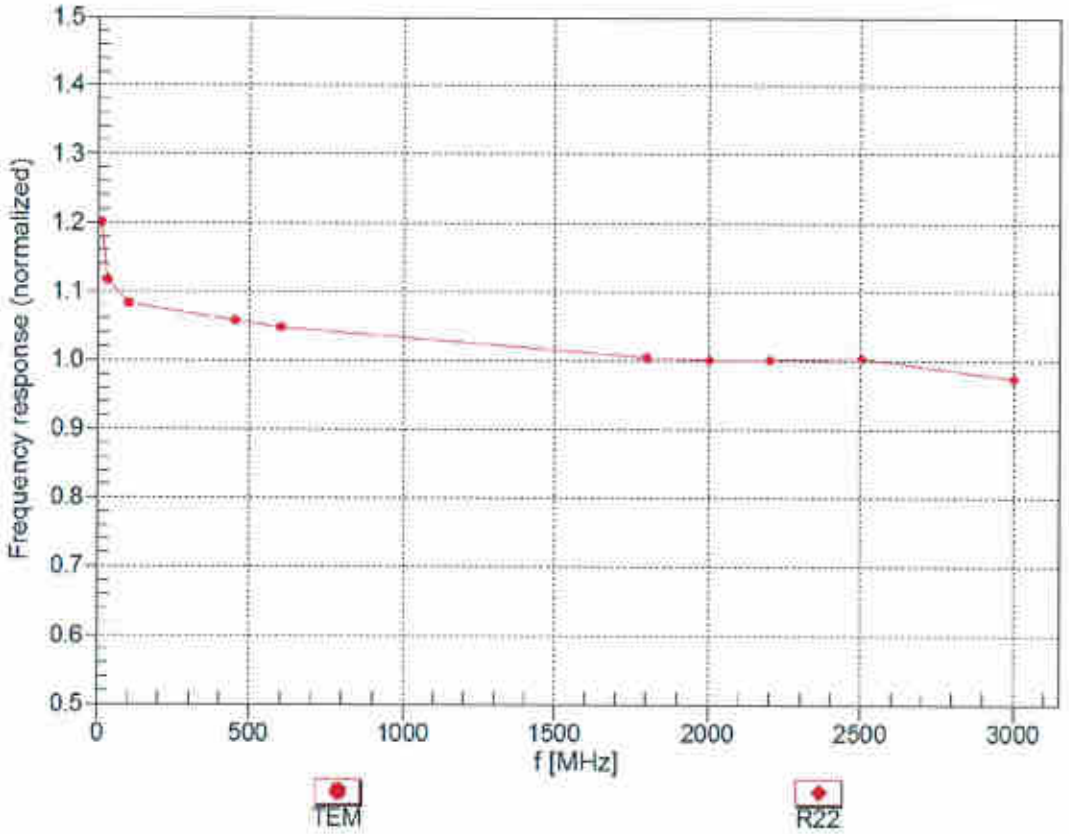
f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unc (k=2)
750	55.5	0.96	9.96	9.96	9.96	0.44	0.80	± 12.0 %
835	55.2	0.97	9.72	9.72	9.72	0.46	0.80	± 12.0 %
1750	53.4	1.49	8.29	8.29	8.29	0.36	0.80	± 12.0 %
1900	53.3	1.52	8.08	8.08	8.08	0.37	0.80	± 12.0 %
2300	52.9	1.81	7.87	7.87	7.87	0.39	0.87	± 12.0 %
2450	52.7	1.95	7.70	7.70	7.70	0.40	0.80	± 12.0 %
2600	52.5	2.16	7.59	7.59	7.59	0.34	0.92	± 12.0 %
3500	51.3	3.31	6.89	6.89	6.89	0.30	1.20	± 13.1 %
3700	51.0	3.55	6.82	6.82	6.82	0.30	1.20	± 13.1 %
5250	48.9	5.36	4.72	4.72	4.72	0.40	1.90	± 13.1 %
5600	48.5	5.77	4.01	4.01	4.01	0.50	1.90	± 13.1 %
5750	48.3	5.94	4.31	4.31	4.31	0.50	1.90	± 13.1 %

[C] Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.

[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

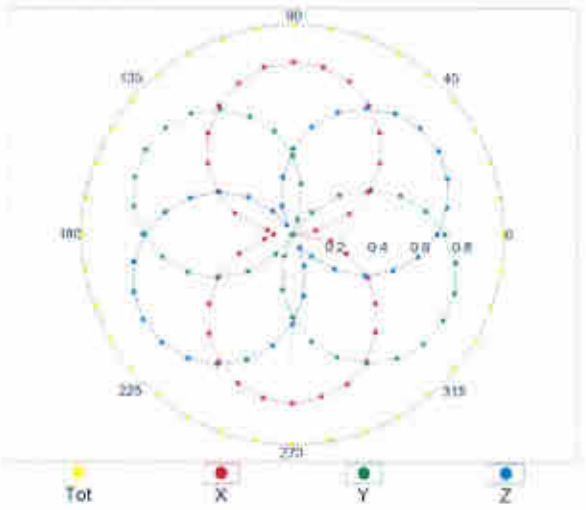
Frequency Response of E-Field
(TEM-Cell:ifi110 EXX, Waveguide: R22)



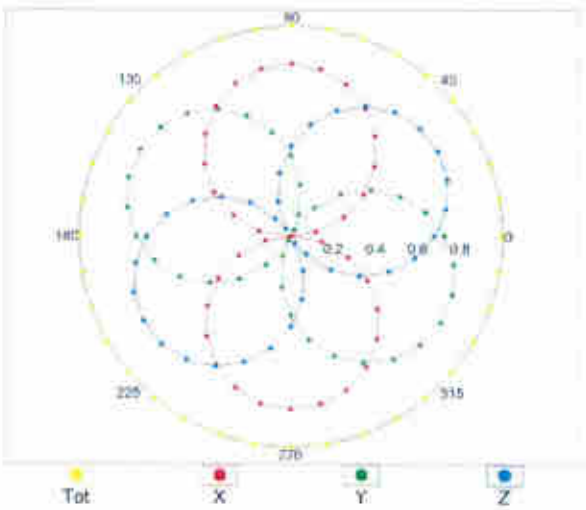
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

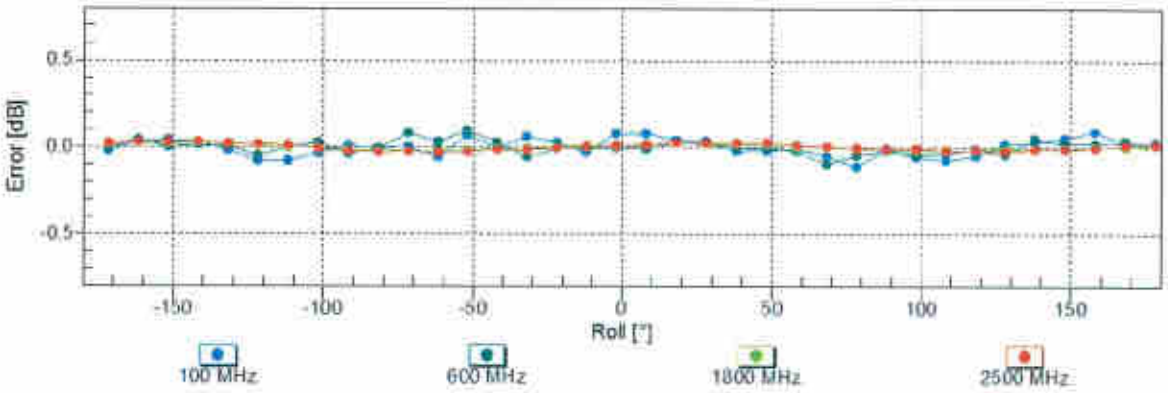
Receiving Pattern (ϕ), ϑ = 0°

f=600 MHz,TEM



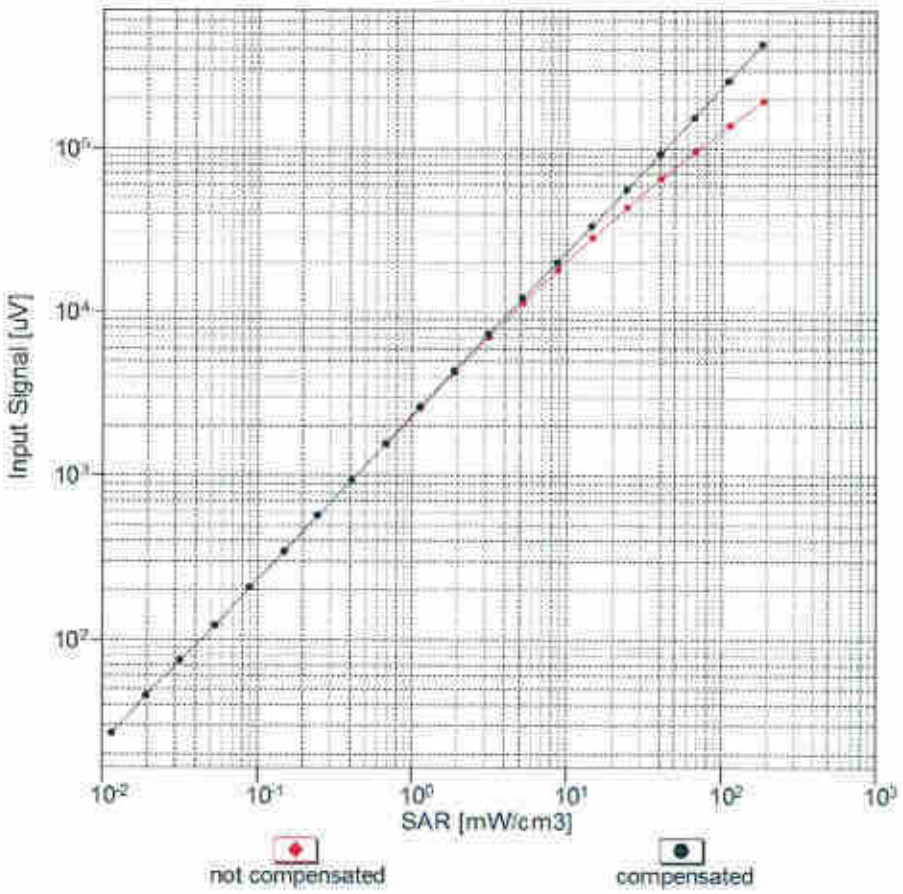
f=1800 MHz,R22

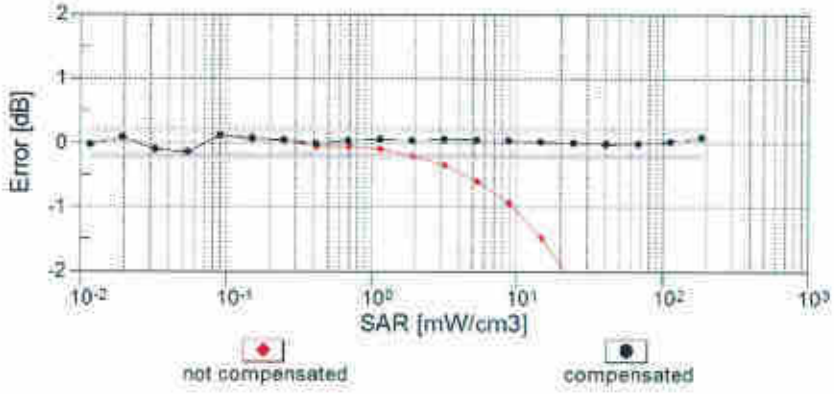




Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

Dynamic Range f(SAR$_{head}$)
(TEM cell , f_{eval}= 1900 MHz)

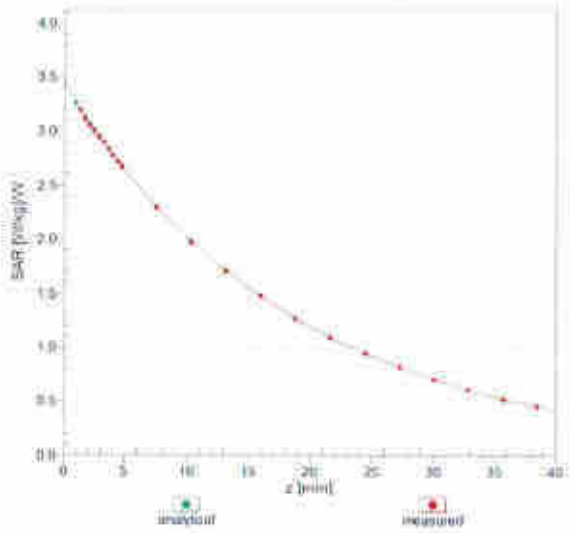




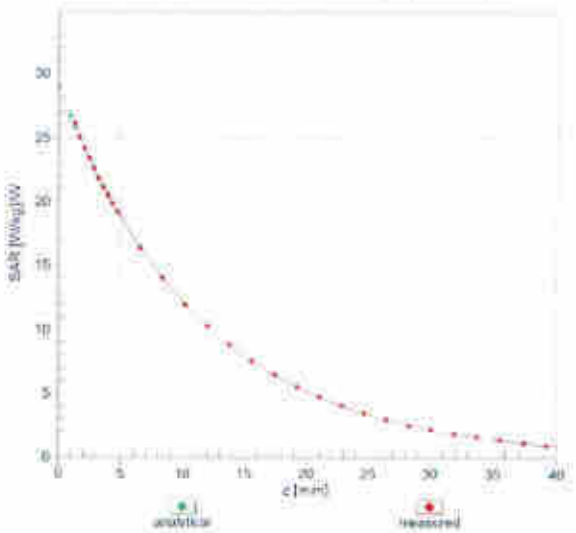
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment

f = 835 MHz,WGLS R9 (H_convF)

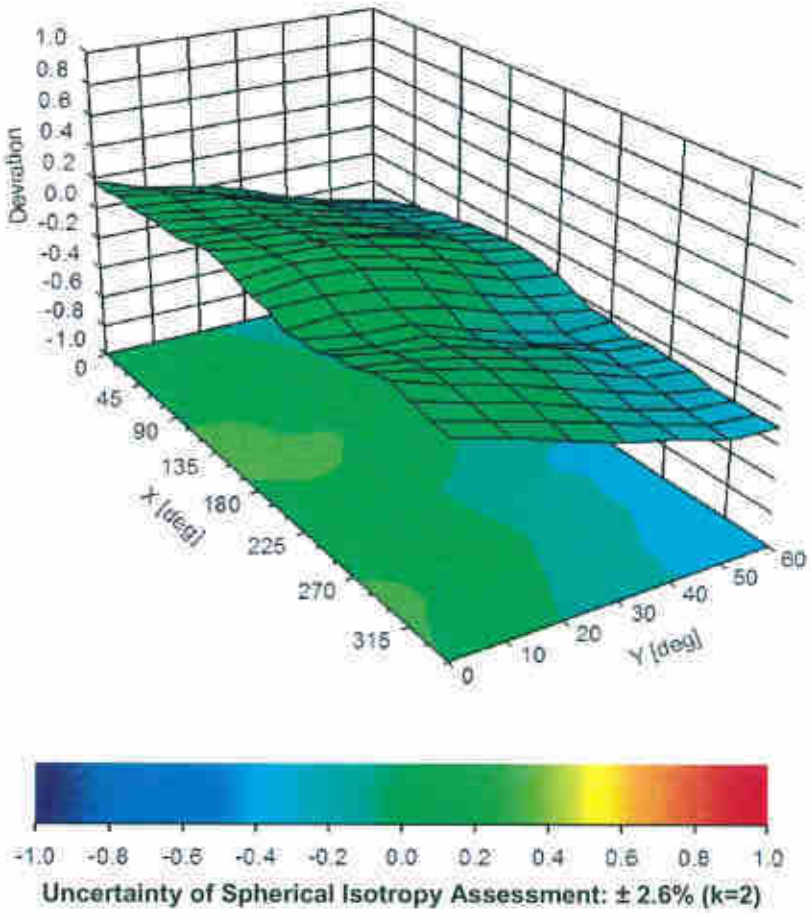


f = 1900 MHz,WGLS R22 (H_convF)



Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz



Uncertainty of Spherical Isotropy Assessment: ± 2.6% (k=2)

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3857

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-41.9
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	9 mm
Tip Diameter	2.5 mm
Probe Tip to Sensor X Calibration Point	1 mm
Probe Tip to Sensor Y Calibration Point	1 mm
Probe Tip to Sensor Z Calibration Point	1 mm
Recommended Measurement Distance from Surface	1.4 mm